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CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

Practical Observations on the Introduction of Preservative Solutions into Railway Timber. By F. Hewson, C. E.

The use of timber upon our railroads is considered indispensable; it is everywhere found in the superstructure of our tracks, and forms the chief material of our bridges; its renewal is the most expensive item of repairs. The life of a sill seldom extends beyond eight years, and the rate of annual depreciation being 12½ ₱ cent., can be applied to the estimate for the durability of the bridges, and those structures which are unprotected against the assaults of heat and moisture, the active and unfailing agents of decay.

There are cycles in the history of a railway like in that of nations; each has its era of good feeling, and the blessings of cheap government, to be followed by discontent and grievous burthens. The close of the first octennial period in the existence of a railroad track, is marked by the entire renewal of its wooden superstructure, involving an additional expenditure for labor. About a year or two preceding this troublesome epoch, the managers and proprietors become alarmed at the rapid and disproportionate increase in their repair accounts; the spirit of economy and reduction is infused into every department, and laudable efforts are made to restore the cheap management of previous years; those efforts are in vain, for the skill and fidelity of their officers and workmen cannot check the onward progress of perishable material to its destiny.

Upon the 25,000 miles of the railway lines in the United States, it is here estimated that 3125 miles of the timber superstructure of their track are annually renewed, requiring an outlay of 3,500,000 dollars to furnish the supply.

These prefatory data show the importance of seeking some effectual method of arresting this enormous waste of capital. The chief obstacle to this end, has been the great outlay required in the outset for the apparatus employed by the usual process, which is so inconvenient in character as to preclude their adoption in the construction of our railroads. These objections of expense and inconvenience are applicable to the systems of Kyan, Bethell, and Sir William Burnett, systems which have been adopted upon the leading works of Europe, by engineers distinguished alike for their genius and soundness of judgment.

Kyan's process is the simple immersion of the timber in corrosive sublimate dissolved in water: it requires the employment of two tanks or reservoirs, into one of which the solution is pumped while the timber is being withdrawn.

It has been severely tested in the dock-yard of Woolwich, and has been employed with success on the Bavarian state railways. The writer has not been able to find any evidence against its efficacy.

The solution is an expensive one, besides being an active poison, which renders its adoption dangerous.

Bethell's process requires a strong cylindrical tank of iron, a steam engine, an air pump, a force pump, and a large wooden cistern or reservoir—when the timber is placed inside the cylinder which is air-tight, a vacuum is obtained, and the solution, which is either coal oil or pyrolignite of iron, is forced under a heavy pressure into the timber.

It has been successfully employed upon the Great Western, the Bristol and Exeter, Manchester and Birmingham, North Eastern, South Eastern, Stockton and Darlington, London and Birmingham, and Cologne and Minden railways. It has received the endorsement of Robert Stephenson, Brunel, Bidder, Braithwaite, and other eminent names.

Sir William Burnett's process employs the chloride of zinc, with the same apparatus and mode of operation used by Bethell. It has been successfully tested on the Hanoverian and the Cologne and Minden lines, and has been used on the Oxford, Worcester and Wolverhampton, the Oxford and Birmingham, and the Vale of Neath railways.

Brunel has taken an active part in its introduction on the public works of England.

There has been a want of confidence relative to the treatment of timber by other systems. The processes of boiling timber or heating it to a high degree of temperature, and suddenly plunging it into the solutions, have been condemned by the highest authorities.

In the Ordnance Manual for the use of the officers of the United States Army, edited by Major Mordecai, assisted by Colonels Baker, Ripley, Huger, and Major Symington, able officers, honored alike for attainments in science and services rendered under the flag of their country, it is stated that "kiln drying is serviceable only for boards

and pieces of small dimensions, and is apt to cause cracks and to impair the strength of wood, unless performed very slowly, and that charring or painting is highly injurious to any but seasoned timber, as it effectually prevents the drying of the inner part of the wood, in which consequently fermentation and decay soon take place. Also in noticing Earle's process, which consists in saturating the wood in a hot solution of copperas and blue vitriol mixed together, has been tried by the ordnance department, but the results have not been favorable as far as regards its effects upon the strength and preservation of the timber." Boucherie also mentions his want of success in rarefying by a regulated heat, the air included in the interior of the wood, and then plunging it at once into the solutions, which he wished to introduce, though by this method, he caused different liquids to penetrate materials of a very compact nature, and he succeeded in forcing tar into stones and bricks to a very great depth. The same authority states, "That it is infinitely more advantageous to act upon wood in its green state, than to prepare it after the time necessary for its complete dessication had sensibly altered it."

Tredgold, in his able and lucid manner, accounts for the effects upon the durability of timber produced by these processes which have thus been condemned—he says, "that it is well known to chemists that slow drying will render many bodies less easy to dissolve, while rapid drying, on the contrary, renders the same bodies more soluble; besides, all wood in drying loses a portion of its carbon, and the more in proportion as the temperature is higher; there is in wood that has been properly seasoned a toughness and elasticity which is not to be found in rapidly dried wood, and this is an evident proof that firm cohesion does not take place when the moisture is dissipated at a high heat."

The evidence of the Saxon and Bohemian railways given in the 29th number of the *Eisenbahnzeitung*, and translated to the valuable columns of the *United States Mining Journal*, practically confirms the unfavorable views of the authorities here quoted.

Additional adverse testimony could still be brought, but its introduction here would extend this communication to a wearisome prolixity.

The employment of the popular European methods of Bethell and Sir William Burnett upon American railways, which are too often started in haste, and without the means sufficient to properly complete them—would be attended with two objections, in some instances so weighty as to prevent their adoption,—they are,

1st. The expense in the first cost of the apparatus required.

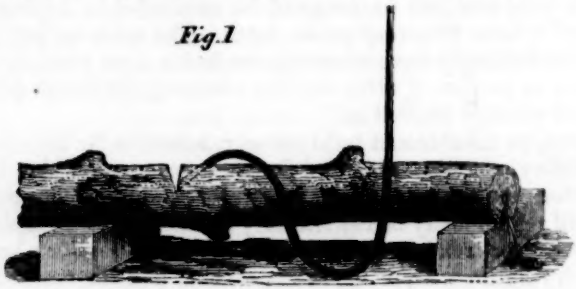
2d. The difficulty in its proper location along the line of a route under construction.

What is wanted is some process which shall be simple, cheap, and efficacious. Boucherie's system of introducing the solutions longitudinally, through the pores or tubes of the timber, by the pressure of a column of any convenient height, is a step in the right direction to meet these necessities. A description of his first methods of operating has already been furnished in previous numbers of the *Journal*.

An account of the more recent improvements which have been adopted is given by Mr. John Reid, Jr., of Glasgow; an extract will not be deemed irrelevant.

"After the tree has been felled, a saw cut is made across the centre through about $\frac{9}{10}$ths of the section of the tree, which is slightly raised at the centre by a lever or wedge so as to open the saw cut a little; a piece of string or chord is placed around the edge of the saw cut, and lowering the tree again, the cut closes on the string, which thus forms a water-tight joint; an auger hole is then bored obliquely into the saw cut from the outside, into which is driven a hollow wooden plug; a flexible tube is fitted on the plug, the end of which is made slightly conical, so that the tube may be pushed tight upon it; the fluid flows from a cistern at an elevation of from 30 to 40 feet." (See Fig. 1.)

Fig.1



Mr. Reid further adds that the timber is most successfully operated upon within ten days after being felled, in which event, the process with a log 9 feet long will occupy twenty-four hours. If the timber is felled three months, three days are required; if four months, four days.

To expedite the longitudinal transmission of solutions, an ingenious and simple apparatus has been contrived by John L. Pott, Esq., the intelligent proprietor of the Orchard Iron Works, in Pottsville; some idea of which can be formed by the following description.

It consists of a force pump, to the cast iron frame of which is bolted a strong cylinder, also of cast iron, 9 ft. long; the inside diameter being 12 inches. Into the further end of the cylinder, a hollow cast iron collar is accurately fitted, but can be withdrawn and replaced at pleasure, the joint being water-tight—from the sectional end of the collar which is foremost in the cylinder, there extends a rectangular punch sharpened and edged with steel, the area of which being less than the cross section of the railroad sills in use. This is driven by beetles into the end of the sill placed in the cylinder, and then firmly secured by strong bolts connected with the apparatus.

This plan of cylinder head makes a water-tight joint, and at the same time allows the sap to escape, and secures a greater pressure at the end of the sill which lies against the pump. The power is applied by hand with a crank.

The writer experimenting with this apparatus, found that in certain classes of timber which were freshly cut, the sap would be driven out

with great force, rapidly followed by the solutions. This was noticed especially with the rock, red, and black oak sills.

Under a heavy pressure varying from 1000 lbs. to 1500 lbs. per square inch, working for about two minutes, the sap for a few seconds would be ejected from the end of the sill; this would flow sometimes in jets like the discharges from the common garden watering pot, and at other times trickling in frothing exudations.

It was found that in white oak sills under the enormous pressure of 1320 lbs. per square inch, the maximum gain in weight was 11½ lbs. per sill, or 3·8 lbs. per cubic foot.

In black oak under 800 lbs., the maximum gain was 17½ lbs. per sill, or 5·8 lbs. per cubic foot.

In red oak under 1400 lbs., the maximum gain in a sill was 29 lbs., or 9·6 lbs. per cubic foot.

In Chestnut under 1500 lbs. per square inch, the maximum gain in a sill was 13 lbs., or 4·3 lbs. per cubic foot.

Upon cutting the sills most successfully operated upon, into thin cross sections of two inches in thickness, they were found to be so fully saturated, that by striking them violently against a board, the solutions would exude and cover the surface with moisture.

Though it required but two minutes in operating the pump for the complete impregnation of the sills, yet the time occupied in adjusting and removing the sill, and in filling and draining the cylinder, amounted to 18 minutes, and the saturation of 25 sills was the average work accomplished in ten hours.

Boucherie's process is held in high esteem by his countrymen; it has been adopted on the Northern, the Eastern, and Nantes railways of France—and has been further sustained by a Board of Engineers of the Ponts et Chausées, and officers of Genise, in a favorable report to the Government.

It has certainly great merit, yet the importance of operating on the timber within a few days after it has been felled, and the manipulation required in its preparation, will cause inconvenience in the construction and repairs of American railroads.

After a close analysis of the cost and details of the various systems, the writer has been induced to select capillary attraction as the agent for introducing the solutions by the correct way shown to us by nature in the vegetative process, viz: by expelling and following the sap longitudinally, through the pores and tubes of the timber.

Preceded by a number of satisfactory experiments, the following plan has been adopted:

The sills are placed vertically with butt ends down in a tightly caulked rectangular tank, 14 ft. long, 6½ ft. wide, and 8 ft. deep, built of 3-inch plank supported by upright stays, and further secured by transverse bolts, which prevent the sides from spreading. (See Fig. 2.)

When the tank is packed with sills, sufficient solution is added to fill it to the top of the sills.

In this simple apparatus, the pressure of a column seven feet in height is thus maintained at the butt end of sill, the sap is expelled,

and the preserving solution takes its place—a tank holding one hundred sills will cost about $70, and weighing when empty, about 2 tons, it can easily be transported to any part of the road.

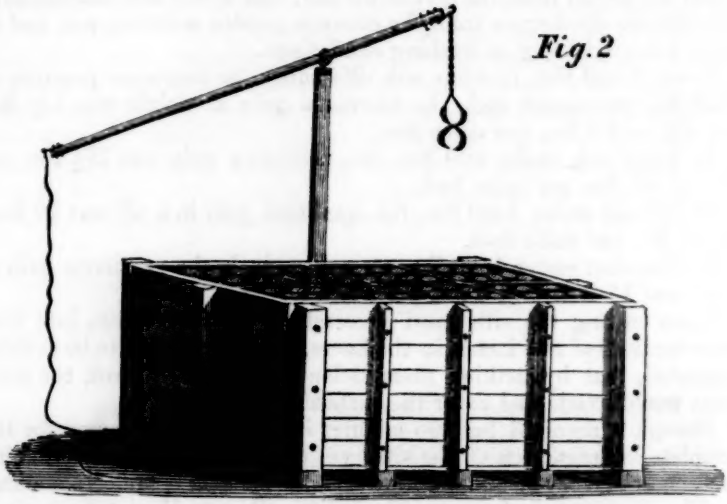


Fig. 2

The number and kind of timber operated upon, together with the weight gained, and the estimated quantity of solution absorbed, are given in the following table: The sills remaining seven days in the tank—the solution consisting of one part of pyrolignite of iron, and six parts water.

Kind of timber.	No. of sills operated upon.	Average pounds gained per sill.	Average pounds gained per cu. ft.	Average gallons per sill.	Average gallons per cubic ft.	Maximum gallons per cubic foot.
White oak,	1038	8·9	3·1	1·8	0·62	1·87
Rock oak,	96	11·5	3·9	2·38	0·78	1·87
Red oak,	153	10·0	3·9	2·04	0·78	1·70
Black oak,	903	9·6	3·6	1·87	0·72	2·64
Chestnut,	143	6·1	3·0	1·20	0·60	1·87
Hemlock,	617	7·5	2·6	1·51	0·52	1·87

After the lapse of seven days the increase of weight in the oaks appeared to be checked. The chestnut and hemlock being slower in absorption would require 14 days to complete their saturation. These facts ascertained by preliminary experiments, account for the discrepancy in the above table in the averages of these classes of timber.

The writer encountered some difficulty in estimating the exact quantity (liquid measure) of the solution absorbed, as the amount of sap displaced in the green timber is considerable, and consequently the estimate of the quantity of the solution absorbed from the weight

gained would be incorrect. After a careful investigation it was found that the increase in the measure of the solution received by the sill, averaged 70 ℅ cent. over and above the quantity called for by the gain in weight of the sill.

This increment is taken into the calculation of the gallon columns of the table.

In order to ascertain the relative extent or degree of absorption of the popular solutions by the different classes of timber, the writer caused to be divided into three equal parts, a rock oak, a white oak, and hemlock sill, each as thus divided was placed vertically in separate casks, which were filled with the solutions.

Cask with the chloride of zinc one pound to 10 gallons of water.
" blue vitriol one pound to 12½ gallons of water.
" the pyrolignite of iron (density 1·101), 1 part pyrolignite to 6 parts water.

After the duration of one week

The *white oak* stick in the chloride of zinc,	gained in weight,	6·8	per cent.
" " blue vitriol,	"	7·9	"
" " pyrolignite of iron,	"	10·7	"
The *rock stick* in the chloride of zinc,	"	4·8	"
" blue vitriol,	"	4·6	"
" pyrolignite of iron,	"	5·6	"
The *hemlock stick* in chloride of zinc,	"	9·7	"
" " blue vitriol,	"	10·1	"
" " pyrolignite of iron,	"	7·6	"

The blue vitriol is absorbed more readily by the hemlock, and the oaks prefer the pyrolignite.

For the impregnation of the heavy timbers used upon bridges and other structures, a large wooden cistern 4½ feet diameter in the clear, and 27 feet deep, was constructed of 3-inch seasoned white pine plank, tightly caulked in the seams, and bound with iron hoops; two courses of 3-inch plank were laid transversely and firmly secured at the bottom of the cistern.

This, when finished by the carpenters, was sunk into the ground until the top edge stood three feet above the surface. A hoisting crane is used in lifting the timber; the sticks being placed in a vertical position in the cistern, which should always be kept filled to its top edge with the solution—in this way, a pressure of a column of 27 feet in height is maintained at the butt end of the timber.

The following table shows the quantity of solution introduced into a cubic foot of the different woods—the solution consisting of one part of pyrolignite of iron and six parts of water:

Kind of timber.	Number of cubic feet.	Average absorption per cubic foot.	Maximum absorption per cubic foot.
White oak,	542	0·53 gallon.	2·72 gallons.
Rock oak,	833	0·71 "	2·04 "
Red oak,	39	0·93 "	1·87 "
Black oak,	67	0·85 "	1·45 "
White pine,	166	1·10 "	2·04 "

Timber freshly cut will receive the solutions more readily than when dry—some pieces of white oak which had been felled three months,

absorbed per cubic foot 76 ℔ cent. more than the same description and sizes of timber which had been twelve months felled.

It was also observed that in pushing some freshly cut beams with a sudden downward force into the cistern, the sap would appear on the top of the beam often in quantities to fill a wine glass.

These facts confirm the opinions of Boucherie, and show that the drying and seasoning of timber to prepare it for impregnation is an unnecessary waste of labor.

The expense of impregnating railway timber with the process advocated by the writer is but trifling.

The labor required is involved only in lifting and carrying the timber, and to this must be added the cost of the solutions absorbed. A statement of the cost of preserving sills with the usual antiseptics is here given.

Chloride of Zinc

In proportions used by Brunel, viz: one pound to 10 gallons of water—cost of chloride of zinc 9 cents per pound.

Labor at tank, lifting and carrying the sills,	1·0 cent.
Solution absorbed, 2 gallons,	1 8
Cost per sill,	2·8 cents.

Blue Vitriol

In the proportions adopted by Boucherie, viz: one pound to 12½ gallons of water, cost of blue vitriol 14 cents per pound.

Labor at tank, &c.,	1·0 cent.
Solution absorbed,	2 24
Cost per sill,	3 24

Pyrolignite of Iron

In the proportions adopted by the writer, viz: 1 part of pyrolignite to 6 parts of water—cost of pyrolignite 23 cents per gallon.

Labor at tank, &c.,	1·0 cent.
Solution absorbed,	6·5
Cost per sill,	7·5

The writer does not claim that this method of impregnating timber by capillary attraction is superior to any process extant, for such an assumption at this period would certainly be premature and somewhat arrogant. The question of its efficacy hangs upon a single point, which is this. Does it introduce a sufficient quantity of the preservative solutions to produce the desired effect? From the mass of data condensed in the tables given above, it appears that the average degree of absorption varies in the different classes of woods. The average of the sills impregnated in the tanks range from 0·52* to 0·78* of a gallon per cubic foot. The averages of the timbers in the cistern from 0·53* to 1·10* of a gallon per cubic foot.

In the interesting account of the Burnettizing establishment, at Gloucester, England, carried on under the direction of J. K. Brunel, Esq., C. E., published by J. B. Francis, Esq., it is stated in the course of describing the operation of the apparatus, that in a partial vacuum, a pressure of 120 lbs. to the square inch is maintained from two to

* American gallons.

four hours until ·6* of a gallon of the solution is forced into each cubic foot of timber, and this amount is deemed sufficient. With this favorable and reliable evidence, the writer is sustained in the opinion that capillary attraction can be advantageously employed as the agent of introducing preservative solutions into railway timber. Its chief merit rests on the simplicity of its requirements in the outset, and the economy of labor in its use.

* Imperial gallons.

Pottsville, Pennsylvania.

Employment of Artillery in Public Works.

From "Nouvelles Annales de la Construction, August, 1858."

They are now working in the "Département de l'Ariége, (France,) on the improvement of the Imperial Route, No. 119, which, according to the location adopted, passes through the grotto of Mas-d'Azil, which has already been opened. At the entrance of the grotto, and at the highest part of the arch, there hung an enormous block of stone, presenting a considerable surface and adhering in a very imperfect manner to the adjacent rock.

Suspended at a height of 197 feet (60 metres) above the road, this rock menaced the safety of the travel; it was very necessary to detach the parts threatening to fall, and to consolidate the rest.

The engineer in charge of the works, saw that in blasting under such circumstances, the difficulties were almost insurmountable, and it seemed that cannon only could dislodge this inaccessible obstacle.

He therefore wrote to the prefect of Ariége to ask him for the assistance of some artillery, when, fortunately, a battery of the 10th regiment of that arm passed through Labastide about ten kilometres from the grotto.

The officer of this battery, having received in the mean time by telegraph, orders to consult with the engineer, and to assist him, if possible, went on the 19th of June to Mas-d'Azil with two pieces (canons obusiers,) of four inches (0·12 m.) diameter.

He placed these pieces on the road at a distance of 820 ft. (250 m.) from the grotto, in such a position, that notwithstanding the height of the rock, the limit of the angle which the gun could make with the horizon was not passed. The two guns threw with a remarkable precision. At the fourth shot the operation was finished, all portions of the rock which had seemed not to be intimately connected with the arch having been removed. The large block remained, but was no longer menacing; to prove its solidity, several balls were lodged in an open crack on the slope of the hill, and during this firing no movement was manifested in the mass, although the projectiles were forced to break off the edges of the rock and to penetrate like wedges.

F. R.

Experiments on the Absolute Strength of Iron and Steel.[•] By M. Meissner, Civ. Eng., Vienna.—From Jour. of Soc. of Engineers, Austria, 1858.

Kind.	Mark.	Dimensions in Vienna sq. inches. Breadth.	Depth.	Cross section, Vienna sq. inches.	Break'g weight Vienna pounds.	Breaking weight per sq. in.	Mean breaking weight per square inch.	Mark.	Cross section of fracture square ins.	Cohesion shown by sect'n of fract.	Mean cohesion per square inch.	Remarks.
1. Shear steel, hard,	I A	0·334	0·327	0·109	9795	89·860	86·852	A I	0·078	125·570	126·100	1. But little change of form just before breaking; without perceptible stretching; broken short; fracture fine-grained.
	B	0·327	0·329	0·107	9910	92·620		B	0·870	127·050		
	C	0·330	0·334	0·112	9650	86·160		C	0·075	128·660		
	D	0·332	0·332	0·111	9250	83 330		D	0·074	125·000		
	E	0·332	0·326	0·109	8970	82·290		E	0·073	123·000		
2. Shear steel, soft,	II A	0·334	0·330	0·110	8350	75·910	77·600	A II	0·065	128·460	130·000	2. (Broken quickly. The bars stretched perceptibly before breaking; fracture fine-grained.
	B	0·280	0·275	0·077	—	—		B	0·050	—		
	C	0·333	0·330	0·110	9100	82·730		C	0·075	121·340		
	D	0·336	0·329	0·111	8590	77·390		D	0·073	117·670		
	E	0 328	0·332	0·109	8100	74·310		E	0·053	153·000		
3. Cast iron, (bloomed with charcoal,)	III A	0·322	0·320	0·103	4300	41·750	41·180	A III	0·048	90·000	99·250	3. Stretched very perceptibly and very long before breaking. Fracture, fibrous, ragged.
	B	0·338	0 338	0·113	4680	41·420		B	0·049	95·520		
	C	0·338	0·338	0·113	4620	40·880		C	0·048	96·240		
	D	0·348	0 349	0·121	4870	40·250		D	0·050	97·400		
	E	0·332	0·320	0·107	4450	41·590		E	0·038	117·100		
4. Cast iron, (puddled with bituminous coal,)	IV A	0·261	0·262	0·068	2690	39·560	39·390	A IV	0 032	84·060	83·500	4. Like No. 3.
	B	0·258	0·252	0·065	2570	39·540		B	0 033	78·000		
	C	0·347	0·340	0·118	4590	38·900		C	0·055	83·460		
	D	0·262	0 259	0·068	2650	38·570		D	0·029	84·500		
	E	0 260	0·256	0·066	2800	42·420		E	0·032	87·500		
5. Cast steel, hard, (not easily welded,)	2 A	0·262	0·265	0·069	7500	108·700	110·190 without B.	2 A	0·048	156·250	148·120	5. Little change of form; no perceptible stretching; short fracture, very fine-grained.
	B	0·255	0·255	0·065	8950	137·690		B	0 062	144·340		
	C	0·261	0·260	0·067	7650	114·180		C	0·049	156·130		
	D	0·260	0·260	0·068	7790	114·560		D	0·055	141·640		
	E	0 271	0·263	0·071	7540	106·200		E	0·053	142·200		
6. Cast steel, soft, (capable of welding,)	4 A	0 336	0·338	0·113	11350	100·440	112·508	4 A	0·064	177·340	167·940	6. Stretched perceptibly before breaking. Fracture, fine-grained in middle; ragged at edges.
	B	0·342	0·338	0 115	14660	127·480		B	0·086	170·470		
	C	0·346	0·346	0 120	13520	112·670		C	0·975	180·300		
	D	0·346	0 346	0·120	13530	112·750		D	0 090	150 000		
	E	0·332	0·334	0·111	12120	109·200		E	0·075	101·610		
7. Cast steel, very soft, (easily welded,)	6 A	0·335	0·335	0·112	10020	89·460	88·976	6 A	0·062	156·550	160 400	7. Stretched until breaking. Fracture, fine-grained in middle; finely ragged at edges.
	B	0·352	0·350	0·124	11250	90·730		B	0 074	152·030		
	C	0·327	0·326	0·106	8950	84·430		C	0·047	190·410		
	D	0·334	0·332	0·111	9740	87·750		D	0·070	139·150		
	E	0·339	0·340	0 115	10650	92·610		E	0·065	163·850		

*Experiments on various modes of Raising Water.** By MM. Morandiere & Compaing.—*Annales des Ponts et Chaussées*, 1857.

Machine.	Day's work in hours.	Cubic metres of water raised by a man one metre high.		Daily wages of workmen.	Cost of 1 cubic metre of water raised 1 metre high.	Cubic metres of water which can be raised per hour.	Cost of hour's work.	Limits within which the method can be used.
I. Archimedes Screw.		per hour.	per day.	Francs	Francs		Francs	Metres.
1. Worked by men,	6	12·75	76·50	2·70	0·035	102·00	3·60	2—4
2. " horses,	—	—	—	—	0·009	85·50	0·75	"
3. " steam,	—	—	—	—	0·0043	165·00	0·70	"
II. Pumps.								
4. Worked by men,	6	9·00	54·00	2·70	0·050	54·00	2·70	1—8
5. " horses,	—	—	—	—	0·011	66·00	0·75	"
6. " steam,	—	—	—	—	0·006	79·00	0·47	"
7. Common water shovel	8	6·00	48·00	2·00	0·042	—	0·25	0—1·2
8. Holland "	8	15·00	120·00	2·00	0·017	—	0·25	"
9. Bucket,	8	4·00	32·00	2·00	0·063	—	0·25	0—1·8
10. Bucket with windlass,	6	15·00	90·00	2·00	0·030	—	0·45	4—20

* Zeitschrift, 1, 1858.

For the Journal of the Franklin Institute.

On the Calculation of the Earthwork of Roads on Sidelong and Irregular Ground. By Prof. Wm. M. Gillespie, of Union College, New York.†

A former article (published in this *Journal*, Dec. 1857, page 372,) investigated the nature of the warped surfaces of ground which usually form the upper or lower faces of the solids removed or added in road excavations and embankments, and showed that the contents of such solids could be calculated with perfect precision by the familiar prismoidal rule. It is now proposed to compare the results given by this rule with those obtained by the usual methods, and to establish formulas by which the nature and the amount of the errors which these latter involve can be determined in advance.

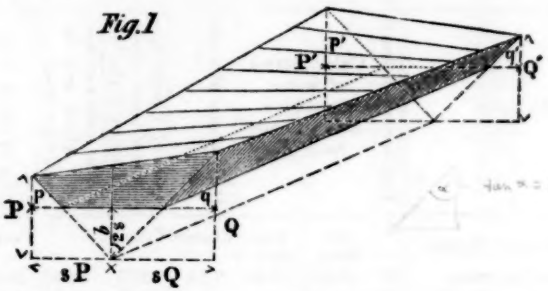
A type of the solids in question is represented in fig. 1, as an excavation seen in perspective. Inverted, it will represent an embankment.

To simplify the investigation, we will conceive the side-slopes to be prolonged till they meet, as shown by the broken lines in the figure. The conclusions at which we may arrive respecting the new solid thus

† An abstract of a portion of this paper was read at the late Baltimore meeting of the "American Association for the advancement of Science."

produced, will apply equally well to the original one, since the triangular prism which we imagine added, is common to both the solids discussed, whatever hypothesis we may adopt respecting their upper

Fig. 1



surfaces. The additional depth is equal to the bottom width divided by twice the ratio of the base of the side-slopes to their height, or to $b \div 2s$, in the usual symbols. We will suppose the original outside depths p, q, p', q', of the end sections, to be increased by this quantity, and will call these new depths, P and Q for one section, and P′ and Q′ for the other.

Then the area of the triangle which forms one end of the new solid, is the difference between the trapezoid whose parallel sides are P and Q, and the two triangles which have P and Q for their altitudes and sP and sQ for their bases, and is

$$\tfrac{1}{2}\,(\mathrm{P}+\mathrm{Q})\times(s\,\mathrm{P}+s\,\mathrm{Q})-\tfrac{1}{2}\,\mathrm{P}\times s\,\mathrm{P}-\tfrac{1}{2}\,\mathrm{Q}\times s\,\mathrm{Q}=s\,\mathrm{P}\,\mathrm{Q}.$$

Similarly, the other end area is sP′Q′. The middle section will have the outside depths, $\frac{1}{2}$ (P+P′) and $\frac{1}{2}$ (Q+Q′). Consequently its area is

$$s\times\tfrac{1}{2}\,(\mathrm{P}+\mathrm{P}')\times\tfrac{1}{2}\,(\mathrm{Q}+\mathrm{Q}')=\tfrac{1}{4}\,s\,(\mathrm{P}+\mathrm{P}')\times(\mathrm{Q}+\mathrm{Q}').$$

The true content of the solid under consideration will then be

$$\tfrac{1}{6}\,l\left[s\,\mathrm{P}\,\mathrm{Q}+s\,\mathrm{P}'\,\mathrm{Q}'+4\times\tfrac{1}{4}\,s\,(\mathrm{P}+\mathrm{P}')\times(\mathrm{Q}+\mathrm{Q}')\right]$$

$$=\tfrac{1}{6}\,s\,l\,(2\,\mathrm{P}\,\mathrm{Q}+2\,\mathrm{P}'\,\mathrm{Q}'+\mathrm{P}\,\mathrm{Q}'+\mathrm{P}'\,\mathrm{Q}), \qquad . \qquad . \qquad (1)$$

We are now prepared to compare with this correct result those given by each of the usual methods of calculation.

I. The method of "*Averaging end areas*" will first be examined. This considers the content of the solid to equal the product of the half sum of its end areas by its length; *i. e.*, using the same symbols as above,

$$\tfrac{1}{2}\,l\,(s\,\mathrm{P}\,\mathrm{Q}+s\,\mathrm{P}'\,\mathrm{Q}'), \qquad . \qquad . \qquad . \qquad (2)$$

The excess, if any, of the true content above this, will therefore be obtained by subtracting (2) from (1). It is found, after a little reduction, to be

$$\tfrac{1}{6}\,s\,l\,(\mathrm{P}\,\mathrm{Q}'+\mathrm{P}'\,\mathrm{Q}-\mathrm{P}\,\mathrm{Q}-\mathrm{P}'\,\mathrm{Q}') \qquad . \qquad (3)$$

The value of this expression is not changed by substituting in it the original depths for the increased depths, (owing to its symmetrical character,) and it then becomes,

$$\tfrac{1}{6}\, s\, l\,(p\,q' + p'\,q - p\,q - p'\,q'), \qquad . \qquad . \qquad (3')$$

We infer from this formula, that *the true content exceeds the content given by "Averaging end areas"* whenever $p\,q' + p'q > p\,q + p'q'$; *i. e., whenever the sum of the products of the pairs of depths (or heights) diagonally opposite to each other, is greater than the sum of the products of those belonging to the same cross-section.* When the former sum is the smaller, then the true result is the smaller. The two sums are the same, and the results therefore equal, only when $p = q'$ or $q = q'$; *i. e.*, when the depths on one or the other side of the solid are the same.

It is so well known, however, that the method of "averaging end areas" *always* gives more than the true content of a prismoid, (such as a tapering stick of timber, a mill-hopper, &c.,) that there seems at first glance an apparent inconsistency in the above statement. The difficulty is removed, however, by the consideration that our warped-surface-solid is not a prismoid, although it is to be calculated by the prismoidal rule. A somewhat analogous case is that of a sphere, to which the prismoidal rule also applies, as shown in the ingenious paper of Mr. Ellwood Morris, in this *Journal*, 2d Series, vol. xxv., p. 381.

II. The method of "Middle areas" will next be taken up. This assumes the content to be equal to the product of the area of the middle cross-section of the solid by its length. This content will therefore be expressed in our symbols thus:

$$\tfrac{1}{4}\, s\, l\,(\mathrm{P} + \mathrm{P}') \times (\mathrm{Q} + \mathrm{Q}'), \qquad . \qquad . \qquad (4)$$

Subtracting this from the true content (1), we obtain, after a little reduction, for the excess of the former,

$$\tfrac{1}{12}\, s\, l\,(\mathrm{P\,Q} + \mathrm{P'Q'} - \mathrm{P\,Q'} - \mathrm{P'Q}), \qquad . \qquad . \qquad (5)$$

For the reasons before given this may be written thus:

$$\tfrac{1}{12}\, s\, l\,(p\,q + p'q' - p\,q' - p'q), \qquad . \qquad . \qquad (5')$$

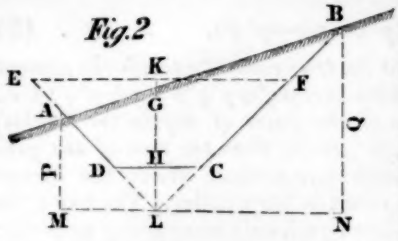
Comparing this expression with (3'), we see that we have merely to *reverse* the deductions there established; and that this method will give results too small when the preceding method gave them too great, and *vice versa*.

The absolute error, however, will be only half so great; the co-efficient in (5') being only one-half so great as that in (3').

III. The method of "Equivalent mean heights" (or depths) is now to be examined. It consists (as is well known to engineers,) in conceiving the given solid to be transformed in such a way that its top surface shall be a plane, every where level crossways at right angles to the length, and that the areas of the ends (which have then become level trapezoids,) shall, at the same time, be equivalent to the original areas. The method then assumes that the content of this new solid (which is a true prismoid,) is equal to the original content of the real sidelong, warped-surface-solid.

This is the method which it has long been customary to employ when perfect accuracy was desired; and most of the tables and diagrams for sidelong and irregular ground are constructed on this hypothesis. The question of its correctness is therefore an important one.

Fig. 2



In Fig. 2, let A B C D be one of the original end areas or cross-sections, and let E F C D be an area equivalent to it, but level on top, if in excavation, as here, or level at bottom, if in embankment. K H, the depth of this new cross-section, is called the "Equivalent mean depth (or height)" of the orignal cross-section. We have first to obtain an expression for it, in terms of the original side depths.

The investigation will be much simplified by the same conception as before, viz: by producing the side slopes till they meet, and calling, as before, the new outside depths P and Q. The height, K L, of the triangle E F L, is what is now wanted. The area of A B L was found on page 12 to be $s\,P\,Q$. Then the area $E\,F\,L = \frac{1}{2} \times K\,L \times E\,F = s\,K\,L^2$, being equated with $s\,P\,Q$, we obtain $K\,L = \sqrt{P\,Q}$.

The equivalent mean heights for the two end areas will then be $\sqrt{P\,Q}$ and $\sqrt{P'\,Q'}$; and the middle equivalent mean height will be their arithmetical mean. The corresponding middle area will be

$$\tfrac{1}{4} s \left(\sqrt{P\,Q} + \sqrt{P'\,Q'} \right)^2 .$$

Using this middle area and the given end areas in the prismoidal rule, we obtain, as the content of the solid by this method,

$$\tfrac{1}{6} l \left[s\,P\,Q + s\,P'\,Q' + s \left(\sqrt{P\,Q} + \sqrt{P'\,Q'} \right)^2 \right]$$

$$= \tfrac{1}{6} s l \left(2\,P\,Q + 2\,P'Q' + 2\sqrt{P\,Q\,P'\,Q'} \right) \quad . \quad . \quad (6)$$

Subtracting this from the true content (1), we find the excess of the latter is, when reduced,

$$\tfrac{1}{6} s l \left(\sqrt{P\,Q'} - \sqrt{P'\,Q} \right)^2 \quad . \quad . \quad . \quad . \quad (7)$$

This expression is always positive, whatever the value of P, Q, P', and Q', with a single exception, when $P\,Q' = P'Q$. Hence we have arrived at this result: *The method of "equivalent mean heights" gives contents always less than the true content;* with one exception, viz: when the products of the pairs of heights diagonally opposite to each other are equal.

IV. Some engineers have conceived the surface of the ground lying between two such cross-sections as we have been discussing, to be formed by two triangular planes meeting in a line running diagonally from p to q', or from p' to q, (see fig. 1), and thus forming a ridge or a hollow situated in this line.* But such cases would be abnormal ones, and such ground would not "vary uniformly" between the cross-sec-

* See Mr. J. B. Henck's very valuable "Field Book for Railroad Engineers," page 100.

tions. We will, however, examine this conception, as it will lead us to some interesting results.

We will begin by supposing the solid to be bounded on its sides by vertical planes passing through the outer side-lines of its surface, and to have its base pass through the line in which the prolonged side-slopes would meet, so that the heights of its corners will be P, Q, P′, Q′, as in the preceding discussion.

Let now the diagonal be considered to run from the left hand corner of the nearest end of the solid to the right hand corner of the farther end; say, from the height P to the height Q′. We now have to get the middle area. The middle height of the diagonal $=\frac{1}{2}(P+Q')$. The middle width of the left hand side of the solid $=\frac{1}{2}(s\,P'+s\,Q')$, and the middle left hand height $=\frac{1}{2}(P+P')$. The middle left hand area is therefore

$$\tfrac{1}{2}\times\tfrac{1}{2}(s\,P'+s\,Q')\times\tfrac{1}{2}(P+Q'+P+P').$$

Similarly we get the middle right hand area

$$=\tfrac{1}{2}\times\tfrac{1}{2}(s\,P+s\,Q)\times\tfrac{1}{2}(P+Q'+Q+Q').$$

The sum of these two areas gives the complete middle area. From it deduct the areas of the triangles on each side of the original solid. The left hand one has its height $=\frac{1}{2}(P+P')$, and its base s times that, and the right hand one has its height $=\frac{1}{2}(Q+Q')$, and its base s times that. Using the middle area thus obtained, with the end areas, in the prismoidal rule, we obtain the content of the solid on the new hypothesis. Its expression may be reduced to the following:

$$\tfrac{1}{2}\,s\,l\,(P\,Q+P'Q'+P\,Q'), \quad . \quad . \quad . \quad (8)$$

Subtracting this from the true content (1), we get for the excess of the latter,

$$\tfrac{1}{6}\,s\,l\,(P'Q-P\,Q'), \quad . \quad . \quad . \quad . \quad (9)$$

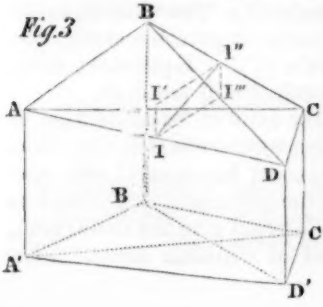
If we next suppose the diagonal to run in the other direction, *i. e.*, from Q to P′, we shall find the excess of the true content then to be

$$\tfrac{1}{6}\,s\,l\,(P\,Q'-P'Q), \quad . \quad . \quad . \quad . \quad (10)$$

Hence we infer that *the error on either hypothesis is numerically the same; though on one in excess and on the other in defect; but that the true content is the greater when the product of the heights which the diagonal joins is less than the product of the other two heights; and vice versa.**

* This admits of the following geometrical proof.
Let A B C D be the surface in question. Consider it to be formed by the two triangular planes A B C, A D C, meeting in A C. Conceive also a vertical plane to pass through A C, A′ C′, thus forming two truncated prisms. Next consider the surface to be formed by planes meeting in B D, and conceive another vertical plane to pass through B D, B′ D′. Two other truncated prisms are thus formed. Now conceive a plane parallel to A B and D C. It will cut the four planes of the hypothesis in lines parallel to A B and D C, and will thus form a parallelogram I I′ I″ I‴. The diagonal I I″ divides the lines A D, B C proportionally, (as follows from the similarity of the triangles formed,) and is therefore a generatrix of the warped surface which lies between the two pairs of planes. But this diagonal of course bisects its parallelogram; the same is true of any other generatrix; consequently the surface which they form is every where midway between the surfaces of the two pairs of truncated prisms, and is therefore equal to half their sum.

Fig.3



It is in this way that the French engineers prove the theorems given in the note on page 375 of vol. xxxiv, Dec. 1857, of this Journal.

Some examples will show the practical bearings of the principles which have now been established.

Example 1. We will begin with the solid represented in fig. 1. It is an excavation a hundred feet in length, all the dimensions being given in feet. Its nearer end has the outside cuttings, $p=6$, and $q=15$; and its farther end has the outside cuttings, $p'=18$; and $q'=12$. The bottom width is 18. The side slopes are 1 to 1. The areas of the ends are 279 and 486. The middle area, obtained from the mean of the outside depths, is 391·5. Then *the true content* of the solid by the prismoidal rule, is 38,850 cubic feet.

Applying to this example the method of "Averaging end areas," we get a content of 38,250 cubic feet, or 600 cubic feet too little. It is too little, because the sum of the products of the depths diagonally opposite to each other is greater than the sum of the products of the depths belonging to the same cross-section. The precise deficiency is given directly by formula (3′).

The method of "Middle areas," gives 39,150 cubic feet, or 300 cubic feet too much; in accordance with formula (5′).

The method of "Equivalent mean heights" comes next. The formula on page 14, gives the "equivalent mean heights" of the two sections as 9·97366 and 14·81176 feet. Their mean gives a "middle area"= 376·65. The corresponding content = 38,860 cubic feet. The deficiency is 990 cubic feet. The same is given in advance by formula (7); since we have (adding $6\div2s=18\div2=9$ to the original depths,) $\mathrm{P}=15$, $\mathrm{Q}=24$, $\mathrm{P}'=27$, and $\mathrm{Q}'=21$; whence,

$$\tfrac{1}{6}\times1\times100\left(\sqrt{15\times21}-\sqrt{27\times24}\right)^2=990.$$

The method of imaginary "Diagonals" gives 33,300 cubic feet, if we suppose the diagonal to run from p to q'; *i. e.*, from 6 to 12, thus forming a hollow; or 44,400 cubic feet, if it runs from p' to q; *i. e.*, from 15 to 18, thus forming a ridge. The deficiency in the former case is 5550 cubic feet; and the excess in the latter case is the same; conformably to formulas (9) and (10).

Example 2. Conceive the outside depths of the farther end of this solid to be interchanged, so that 12 may be on the left and 18 on the right. The true content will then be 37,950 cubic feet.

But "Averaging end areas" still gives the same as before, viz; 38,250 cubic feet. It was less than the true content in the former case, but it is now more, in accordance with formula (3′). The "Middle area" method gives 37,800, or too little, while before it gave too much; this result being still in accordance with formula (5′). "Equivalent mean heights" give the same as before, and therefore still too little.

Example 3. Conceive the depth q', of the solid of Example 1, to be changed from 12 to 15, all the other dimensions remaining the same. The new end area is 567, and the true content becomes 42,300 cubic feet. But $q=q'$. Therefore, according to the principles established on page 13, the method of "Averaging areas" should give the same result, and it does so. So too with the method of "Middle areas." The

method of "Equivalent mean heights," however, still gives too little, because $P \times Q'$ is not equal to $P' \times Q$. On making the calculation (the equivalent heights being 9·97366 and 13·21475,) we get a content = 41,600 cubic feet, or 700 cubic feet too little; and formula (7) gives the same result.

Example 4. In another warped surface solid, let one end area have depths of 15 on the left and 5 on the right, and the other end be 5 on the left and 15 on the right. Let the breadth of road bed be 20 feet and the side slopes 2 to 1. The true content will be 38,333 cubic feet. The "Averaging method" gives 35,000 cubic feet; too little by formula (3′), because

$$5 \times 5 + 15 \times 15 > 15 \times 5 + 15 \times 5.$$

The "Middle area" method gives 40,000 cubic feet, an error in excess of half the amount of the preceding deficiency. "Equivalent mean heights" give 35,000 cubic feet; not enough, because $P \times Q'$, or, 20×20 (adding $20 \div 2 \times 2$ to the given depths) is not equal to $P' \times Q$, or 20×20.

Example 5. Reverse one of these sections so that both may be 15 on the left and both be 5 on the right. The surface is then a plane, and the solid is a prism with a uniform section of 3500 square feet. For this solid all the methods give the same content; and this is a final corroboration of our formulas. The "Averaging" method is now correct, because $p = p'$, each being 15, or because $q = q'$, each being 5. The "Middle area" method is correct for the same reason. The method of "Equivalent mean heights" is now correct, because now $PQ = P'Q$.

The method of "Equivalent mean heights" which the preceding investigation most particularly affects, seems to have been introduced by Telford, and has since been adopted without question by most writers (the present one included,) *when perfect accuracy was desired.* The difficulty has been the want of any better standard than itself with which to compare its results. But if the positions which the former paper of the writer endeavored to establish be accepted as correct, this method should be at once and entirely abandoned—since its errors are not of the kind which balance each other in the long run, but are always on the same side—since they are committed too with a belief of its perfect accuracy, and therefore in the most important and delicate cases—and since they may sometimes be of serious moment, the deficiency of the first example given being more than $2\frac{1}{2}$ ₱ cent. of the whole amount; no trifling item in a class of work which on some railroads is counted by millions of yards.

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*Canals and Canal Conveyance.** By W. O'Brien, C. E.

[Extracts from the Prize Essay on Canals and Canal Conveyance for which a premium of £100 was awarded by the Canal Association.]

The dimensions of canals vary according to local considerations, and also according to the notions of engineers. In England there are two

* From the Lond. Civ. Eng. and Arch. Journal, Oct., 1858.

systems of canals: the narrow, with locks 7 feet wide, accessible to boats of 30 to 35 tons; and the broad, with locks 14 to 18 feet wide, and accessible to boats of 60 to 120 tons, the latter however being built without any regard to speed. In the broad canals the width at the surface of the water is about 40 feet. The canals in the north-west of France are accessible to boats of as much as 500 tons, if built in a certain manner, but few convey more than 200 tons freight. The locks most prevalent are 100 feet long by 18 feet wide, the depth of water being from 5 to 7 feet. A great many North American canals admit large vessels under sail. In the North Holland Canal two frigates can pass each other with ease.

A great number of rules have been given for calculating the resistance opposed to the movement of boats on canals; none of them can be relied on; in some cases they only give the relative and not the absolute resistance; in others they give the absolute resistance, but only for old-fashioned boats, which are not likely to be used much longer for traffic on canals. Some notion of the absolute resistance may be obtained from "Wood's Practical Treatise on Railroads."

The following formula is from Claudel's work:

$$E = k\frac{A\,V^2}{2\,g}$$

E, effort in kilogrammes; k, coefficient constant with the same boat; A, area of greatest immersed transverse section in square metres; V, speed in metres per second; g, 9·81 metres = 32·17 feet.

If we reduce this to English measures, that is, pressure in pounds and length in feet, we have

$$E = 0{\cdot}80\,K\,AV^2 \quad . \quad . \quad (1)$$

K having the same signification as before.

K = 1·10 when the boat is a straight prism of which the length is 5 or 6 times its width.

If we suppose the front or bow of the boat to be formed by two vertical planes forming a certain angle with the longitudinal axis of the boat, the values of K according to this angle are

Angle of 78°____30°____6°____bow semicircular.

K=1·05____0.48____0·44____0·57, and with a stern formed by two planes forming an angle of 45° with the boat's keel, these values are

$$K = 0{\cdot}94\text{____}0{\cdot}37\text{____}0{\cdot}33\text{____}0{\cdot}46.$$

K is stated with some fast American steamers to descend as low as 0·045.

The formula (1) shows that, all other circumstances being the same, the effort of traction increases as the square of the velocities; this appears to be true only up to a certain velocity, beyond which it appears that the boat is raised and displaces less water, so that the value of E increases less rapidly than the square of the velocities. The value of K is greater on a canal than in an unlimited expanse of water: cer-

tain experiments tend to show that there is a limit beyond which the diminution of the canal's sectional area does not raise the value of K, but is rather advantageous.

The duty performed by an engine in propelling a boat to a certain distance:—D is expressed by the equation

$$DE = 0{\cdot}80\ K\ AV^2\ D.$$

But if the work is done by a horse harnessed to a rope which forms an angle a with the direction of the boat's movement, the equation becomes

$$E.D \cos. a = 0{\cdot}80\ K\ AV^2\ D,$$

part of the horse's power being lost from obliquity of the rope.

Urging horses to a trot in towing boats appears to fatigue them very much, and was only practised for a short time with passenger boats. In France two horses haul a boat with about 100 tons at the rate of about 2 miles an hour. In England one horse hauls a boat with 20 to 30 tons at the rate of $2\frac{1}{2}$ miles. In Holland they go quicker.

For determining the power of the engines of a steamer, the dimensions of which are known, the formula given by Claudel in French measures is

$$\frac{F.Y}{75} = \frac{V^3}{2g} K{\cdot}A \left(1 + \frac{K.A}{K;A}\right)$$

which gives in English measures,—horse power, or

$$\text{H. P.} = 60.\ V^3.K.\ A \left(1 + \frac{K.A}{K;A}\right) \quad . \quad (2)$$

A is the area of one paddle-board or of two if two paddles are used, in square feet; V, the boat's speed in feet per minute; K, coefficient, varying from 1 to 1·2. This formula supposes the speed to be uniform.

The coefficients, K and K, can be determined approximately by comparison with boats already experimented on. K, may be assumed at 1·1.

If we determine, besides the speed to be attained, the dimensions of the boat and the probable depth of immersion, formula (2) will enable us to determine the horse power of the engines.

$$\frac{a\ \pi\ s}{33000} = \text{H. P.} \quad . \quad . \quad . \quad (3)$$

a, area of cylinder in square inches; π, effective pressure of steam on piston in pounds per square inch; s, speed of piston in feet per minute.

The effective pressure is here assumed to be that indicated by the pressure gauge; whereas it is always a little inferior in the cylinders, and varies if expansion is used,—as of course it should be.

If a screw is applied instead of paddles, formula (2) is still applicable, if A be equal to the area of the vertical projection of the screw, and V equal to the velocity of the screw in the direction of the boat's movement.

The shape and dimensions of boats used on canals can only vary within narrow limits. It was formerly admitted that the lines of ves-

sels should be convex in front: experience has proved that hollow lines are best, both for sea and river boats.

In Europe both river and sea going vessels are usually built with the stem raking forward: this creates a wave in front of the stem. The Americans have introduced the fashion of stems running straight up from the surface of the water.

The form of the stern lines has a great deal to do not only with the steering of vessels, but also with their speed.

Except in sea boats the form of a boat's lines above the water is of little consequence. Deep keel and great draft of water are necessary for the stability of sea-going boats. River and canal boats require a flat floor and no keel.

It cannot be expected that canal boats should be as fast sailers as river boats, but we should try and copy them as far as is compatible with the requirements of a canal navigation. Fine lines not only give speed,—they cause a saving in the cost of propulsion.

History of Canals.

Canals must have been used at a very early age, if not for navigation, at least for irrigation of land: they appear to have been made in Egypt at a very early period. Some time after, they were applied to the cultivation and irrigation of land in Lombardy. The first important step taken with a view to apply canals on a large scale to navigation, namely, the invention of locks, is attributed to Leonardo da Vinci, towards the year 1500. Notwithstanding the importance of this invention, inland conveyance by means of canals does not appear to have been much used till the year 1612, when a Frenchman (Pierre Paul Riquet,) presented Louis XIV. with a project for a canal from the Mediterranean to the Bay of Biscay, which was commenced under M. Riquet's auspices and at his expense. The execution of this canal has only been finished within a few years, and even now works are still going on for enlarging it and improving the supply of water. The works are let to a company, entitled Compagnie du Canal du Midi, by which name the canal is now known. This appears to have been the first attempt to make canals a general mode of internal communication. The Belgian and Dutch canals were begun before, but not under the same difficulties.

The Canal de Briare appears soon after the Canal du Languedoc; it was opened in 1642. England was far behind the continent in canal engineering; but when once the Duke of Bridgewater had set the example, the English capitalists set on in right earnest. It is a curious fact, that while on the continent the development of those two great instruments of progress, railroads and canals, was gradual, and can be traced rather to the increasing wants of the country, than to the leading influence of any individual; in England, on the contrary, their development was so rapid as to assume the form of a mania, and that almost entirely owing to a few men, more particularly Brindley for canals, and George Stephenson for railroads.

The French, however, boast of their Brisson, engineer-in-chief of the Ponts et Chaussées, who devoted several years to perfecting some of the most important canal lines in France, more particularly the northern navigation by St. Quentin and the Oise, the canal parallel to the Somme, and those from the Rhône and Marne rivers to the Rhine.

A canal cannot be too wide if it can be supplied with water. A blunder evident to all engineers was committed both in England and in France, in giving the locks, bridges, viaducts, &c., only just width enough for the passage of one boat, so that any considerable increase in the activity of the traffic or the size of the boats will compel the canal owners to pull them down and rebuild them entirely.

The idea of applying steam power on canals is as old as the application of the steamboat itself: it was tried on the Forth and Clyde canal in 1802, but was abandoned on account of the surge caused by the paddles washing the banks of the canal. In 1812, fresh trials were made, and the banks of the canal protected by a coarse stone pitching. The screw was tried with very good results on the grand canal in 1851. Paddle-boats have not been long in use on French and Belgian canals; the screw has only been in use since 1800, or thereabout, on French canals. Passenger boats tracked by post horses were tried in England and Scotland at the beignning of the 19th century, but were abandoned soon afterwards.

It must not be forgotten that canals were chiefly executed before railways were even thought of; they were made simply with the view of obtaining a better means of communication than that afforded by common roads. This explains the enormous value which canal property had in England for some years.

In Belgium, canals and railroads both belong to government; there has been scarcely any struggle between the railway and canal interests. In France the government owning most of the canals, and having advanced large sums of money for the construction of railways, was obliged to divide its solicitude between the canals and railways. In England the two systems led to a long struggle: the canal owners tried altogether to prevent the public from having railways, at least for the conveyance of heavy goods. After several violent parliamentary contests, the railway owners, not content with gaining their cause by obtaining an act of concession, turned all their efforts to ruin the canal owners by conveying traffic at the lowest rates, frequently at their own loss. Instead of trying to ruin the railway interest in England, the canal owners ought rather to have sought means of satisfying the public wants, in such a manner as to induce carriers to adopt the canal rather than the railway. But they had enjoyed for years such a complete monopoly, that improvement was thought of too late, and the canals were bought or silenced in many instances by the railway companies.

Present Position of Canals.

There are five different modes of conveying goods: 1. Coasting or maritime navigation; 2. Navigation on rivers; 3. Navigation on canals; 4. Common roads; 5. Railroads.

Wherever the first mode of conveyance can be adopted without materially increasing the distance, and if very great velocity is not required, it is and alway will be preferred. Allowing for sea risks, it is still the cheapest of all the five, and offers great facilities for loading and unloading, and for stowing goods in the best manner for their preservation. The application of the auxiliary screw system will not probably, on an average, raise the price of freight considerably, as the increase of working expenses which it causes is compensated by a great saving in time.

Common roads will ere long cease to be applicable except for short distances, or in very rugged and mountainous countries. They certainly offer one advantage: it is, that they can be made everywhere, and in some places offer the only mode of conveyance possible.

Railroads are less expensive, but except at high velocities are more so, than every kind of navigation. The characteristic advantage of railways is the enormous velocities which they allow one to attain.

The resistance on roads and railways is independent of the rate of velocity. On the latter it is about ·86 of that on roads. The resistance to a boat's movement varies as the square of the velocities, and at a speed little exceeding 4 miles an hour is superior to that on railroads. No limit scarcely can be assigned to the velocity attained on a railway. What advantages does navigation offer to compensate for the loss of such an important one as this? It offers first, that of economy; and secondly, that of being able to convey almost unlimited quantities in a given time; for we find in formula (1) that the resistance in this case varies but little with the length of the vessel, an increased length having only for effect a slight alteration in the value of K, so that thousands of tons can be conveyed by a single boat at sea or by a single train of boats on a river or canal, at a moderate expenditure.

Canals chiefly differ from rivers as regards the cost of conveyance, in requiring a greater outlay of capital, and being generally narrow, the motive power is not applied in the most advantageous manner; they are consequently less advantageous as a means of conveyance than rivers, unless the latter have a rapid current, or are much longer on account of windings.

The competition between railways and canals is a very serious question; the railway companies trying to absorb all the traffic of heavy goods, and run down the canal owners. It has been seriously considered by the French and Belgian governments, and has ended in their maintaining and even extending their canals, and reducing the tolls.

Having considered these five means of communication, it is easy to see that each of them offers special advantages, so that for many things it cannot be well replaced by any of the others; it is therefore not reasonable to suppose that one or two of them will absorb and supersede the others. None of them have attained the degree of perfection of which they are capable. If they had, the cost of conveyance of goods would not increase their value four or five fold, as is frequently

the case. Coal worth seven or eight shillings a ton at the pit's mouth is worth twenty or thirty at 200 miles distance.

It is argued against canals and in favor of railways,

1. That the cost of haulage is not much greater on railways than canals.

2. That railways offer such great advantages in point of speed as to compensate for increased cost of conveyance.

3. That it is quite practicable to convey on railways bulky goods, as building materials or minerals.

4. That if the profits derived by the conveyance of bulky goods are not very considerable, still the traffic can be absorbed, because a handsome profit is realized from the passenger traffic.

5. Puplic opinion is in favor of railways.

6. All canal property has lost a great deal of its value since the opening of railroads.

7. The continually increasing traffic on railroads proves that the public prefer that mode of conveyance for goods.

8. Canals are frozen, consequently impassable, for a certain length of time every year.

The first argument, that of cheapness, is not exact; up to a speed of about 4½ miles an hour the resistance on canals is, as we have seen, inferior to that on railways. The cost of establishment and that of repairs and management on canals are also inferior. The use of condensing engines and coal fuel render the cost of the moving power less by water than on railways, so that a speed considerably above 4½ miles per hour may be attained at a cost still inferior to that of railways.

The second argument is granted, but only with certain materials. Builders and contractors frequently order building materials and minerals three, four, and six months beforehand, without any inconvenience, and they have the great advantage of loading and unloading when it suits them; whereas with railways, space being valuable, all goods must be removed at the shortest notice, or else heavy dues must be paid for leaving the goods at the station.

Among the articles for which canals seem eminently convenient are the following:

Bulky articles—timber, bricks, stone, large castings.

Fragile articles—glass and pottery not packed in cases.

Articles of small value—ore, minerals, ashes, manure, &c.

Thirdly. It is very doubtful whether railways could furnish the sole medium for the conveyance of bulky articles. To do this the goods trains must travel at the same speed as the passenger trains, to the sacrifice of that important item of economy in the working of steam engines, expansion; if not, a third line must be laid down at a vast cost, for the sole transit of merchandize, or else the lives of passengers must be daily jeopardized to an extent far greater than what we observe even at present.

Fourthly. M. Perdonnet says that in may cases—as in that of the

French Northern Railroad, those of Rouen, Strasbourg, and Orleans, that from London to Birmingham and from London to Bristol—the profits derived from the conveyance of passengers and parcels suffice to pay the interest of the capital and the general expenses, so that the companies can content themselves with very small profits on the goods traffic. This is open to discussion, for it is very difficult to separate the passengers and the goods account so completely as to tell exactly what are the profits relative to each.

Fifthly. Public opinion is no criterion. There are many reasons why railways should attract public attention more than canals. The convenience in traveling, the wonderful speed, &c.

The sixth argument cannot be denied; but too much importance must not be given to it. Suppose, instead of constructing railroads parallel to those canals which have most suffered as a property since their establishment, we had established parallel lines of navigation,—would not the results have been very similar?

As to the seventh argument, it is refuted by observing that in France and Belgium the traffic on canals has gone on increasing since the establishment of railways parallel to them.

Eighthly. The effects of frost can only be palliated; but I think they are not more incovenient than a heavy fall of snow in a railway cutting, and are much less so than an interruption in the permanent way.

All these arguments therefore can only prove that canals have a severe struggle to keep up with railways. I will add in favor of maintaining, extending, and improving our canal navigation, that the public, whose attention has been entirely absorbed by railways, has neglected the vast field for improvement offered by canals in general, and by those of England perhaps more than any other.

How the struggle between railway and canal companies is to end is diffiult to say. United action on the part of the canal proprietors will be beneficial, and a community of interests between the canal owners and carriers will be still more so.

Attempts have been made to connect canals with irrigation of land, or with works for the supply of water, or with hydraulic machines for manufactures. The Canal de l'Ourcq, at Paris, serves both for the purposes of navigation and water supply.

As to irrigation and hydraulic machinery, they may in some cases be made a considerable source of income to the canal owners; but more generally all the water is absorbed for the wants of the canal.

Improvements suggested with reference to Canal Engineering and Navigation.

The first step towards improvement is the application of steam power to the exclusion of any other. The advantages offered by the use of steam, are:

1. *Economy.*—It is impossible to give any absolute estimate of the cost of conveyance with steamers and horses. The cost of steam power in particular is very variable; but the following estimate will give an

of the difference in the working expenses, exclusive of loading and unloading and general expenses, which are nearly the same in each case.

Suppose it be required to convey 60 tons 100 miles.—A boat hauled by one horse will perform the distance in 48 hours.

	£	*s.*	*d.*
The horse and driver at 6*d.* per mile will cost,	2	10	0
Wages of crew, two days,	1	0	0
Interest and wear and tear of boat,	0	2	0
	£3	12	0

A steamer with engines of 16 to 20 H. P. can convey 60 tons 100 miles in 20 hours. The cost will be about as follows:

	£	*s.*	*d.*
Coal, 2 tons at 15*s.*,	1	10	0
Wages of crew, one day,	1	0	0
Interest and wear and tear of engines and boat,	0	5	6
Oil, &c.,	0	3	0
	£2	8	6
Difference in favor of steam power,	1	3	6*

Or nearly ·005*d.* per ton per mile.

2. The facility of increasing momentarily the moving power by reducing expansion and raising the pressure.

3. That of conveying indefinitely large quantities of goods according to the power of the engine, an object which cannot be attained with horses.

4. That of being perfectly self-dependent, whereas horses constantly occasion difficulties.

5. That of allowing the towing-path to be suppressed, causing a very great saving of space in deep cuttings and tunnels, which may thus be made available in other ways.

6. Saving of time. Any speed within 15 miles an hour is easily attainable, instead of 2 or 2½ miles, which is the pace of horses; but 4 or 5 miles an hour appear to be a good average.

Suppose a boat towed by horses to convey in one trip 60 tons to a given distance, and 30 tons back: the carrier will gain, say 20*s.* for the first trip, 10*s.* on the next; total, 30*s.*

The steamer will probably make two trips in the same time, conveying twice 60 tons to the same place, and twice 30 tons back. The boatman can make the same charge on each trip, and gain £3. But he will probably content himself with £2, thus sharing with the public the benefits derived by the improvement; and in any case a saving in time for the public will be effected. The number of boats forming the rolling stock will be diminished by half.

The next step is to introduce the *train* system. That towing is cheaper than carrying has been demonstrated more than once by actual

* This is so printed in the original, but it evidently should be £0 13*s.* 6*d.*, or nearly ·0033*d.* per mile.

experiment. I have shown before that at a given speed the length of the boat makes very little difference, the area of the immerged transverse section having the most influence on the resistance, so that with an indefinitely long vessel the cost of traction would be but little increased: as this is impracticable, we must obtain an approximation by the use of boats towed one astern of the other. This system has been long in use in America. The introduction of steam necessitates certain alterations in the dimensions of canals: first, the section of the canals and the dimensions of the locks must be increased.

(To be Continued.)

For the Journal of the Franklin Institute.

Mid-Lothian Coal Mines, Virginia.—Cornish Pumping Engine, &c.

By Joseph Buzzo, M. E.

The mines of the Mid-Lothian Coal Mining Company are situated in Chesterfield County, thirteen miles from Richmond, and a half a mile from the Richmond and Danville Railroad—a branch track from that road connects the mines with their shipping point, opposite Richmond.

This Company has been formed and in successful operation for about 20 years. They now own about 2000 acres in the heart of the Chesterfield bituminous coal basin. The coal is considered of superior quality for gas, grate, and forge purposes, and finds a ready market. The average thickness of the seam of coal, varying from 4 to 50 feet, may be estimated at about 20 feet. Several vertical shafts varying in depths from 550 to 771 feet have been sunk through the vein at different points, and communication effected from one to the other, which gives good ventilation to the underground workings.

By the aid of three large hoisting engines they are able to raise a large quantity of coal. The Company are now engaged in sinking a new shaft near the centre of their ground, which they expect to complete in twelve months; and which, when completed, will open to them an additional valuable field of coal. About two years ago this Company leased a small piece of land adjoining their mines through which, than from any other point, coal could be more advantageously raised; and drove a drift into what was considered an unwrought piece of coal, when suddenly they cut into an old drift connected with extensive underground workings filled with water. This communication was at the highest point of the Company's workings; and as the old workings cut into were connected with vertical shafts 4 or 500 feet deep, and filled with water, the force with which the water poured into their works was enormous. It swept away thousands of the timbers in its route, washed up the railway tracks, knocked down large quantities of coal, in a few minutes filled the workings, and stood 40 feet above the drifts in the principal vertical shafts. This accident occurred fortunately

about midnight, when only 15 hands were below, ten of whom were lost. Previous to this the water had been kept out of the mines by large buckets fixed in cages and worked by the hoisting engines at night; but now so large a quantity had come in at once, and additional feeders having been cut, it was found that the whole power of all their hoisting engines, working day and night, was only sufficient to keep the water at bay, and that some additional power would be necessary to free the mines.

By taking accurate measurements of the buckets, and keeping an account of the number raised, it was ascertained that the quantity coming in in 24 hours was about 220,000 gallons.

It was determined to erect a pumping engine of sufficient power to drain the whole of the workings, leaving the hoisting engines for the exclusive purpose of raising coal.

After due investigation by the Directors in regard to the best kind of pumping engine now in use, in the course of which, advice was taken from various engineers, it was finally, only on the urgent recommendation and by the advice of Wm. W. Wood, Esq., Chief Engineer, U. S. N., that it was decided to erect a Cornish pumping engine, of the most improved kind. Proposals were invited from the principal foundries of the country for building such an engine. Those of Messrs. Merrick & Sons, engineers, and proprietors of the Southwark Foundry, Philadelphia, were accepted, and preparations immediately commenced at the mines for erecting the machinery. Here many difficulties presented themselves. All the fixtures and pit-head had to be removed, and it was then ascertained that the curbing timbers of the shaft would have to be renewed.

This was a work of difficulty and danger, for the soft nature of the materials near the surface caused the sides of the shaft to cave in as soon as the old timbers were removed. Great precaution had then to be exercised in saving the shaft and protecting the workmen. It was accomplished in five or six months without any injury to the men, and the shaft re-cribbed with foot square timbers.

The foundation of the engine house, which is within a few feet of the shaft, had to be quite deep, and from its great weight it was feared it would crush in the sides of the shaft. To prevent this, heavy timbers, 20 inches square and 28 feet long, were placed below the foundation between it and the shaft, and extending eight feet on each side of the shaft into the solid earth.

The foundation is of granite about 20 feet deep, the cylinder pillar of the same material and depth, and 17 by 24 feet. The beam (or bob) pillar, which is the front wall of the engine house, is of the same material, 24 feet wide, 6 feet thick to surface line, and 5 feet thick above that line, and 27 feet 6 inches above the surface. The rest of the engine house is of brick, with walls 34 inches thick. The boilers are in a separate house, in the rear of, and connected with, the engine house.

The engine is a "beam Cornish." Its cylinder is 60 inches diameter with 10 feet stroke of piston. The piston is packed with a single cast

iron ring, bored eccentrically and slit and tongued on the thinnest side; being kept central and in contact by four springs. The beam is of equal lengths, 28 feet 6 ins. from centre to centre of end pins, having wrought iron catch-pieces. It is double, and besides being of the usual proportion for strength, is banded by heavy wrought iron bands on the upper side, put on hot, and extending from under side of bosses around them, and over horns cast with the beams on their upper side. The total weight of the beam and centre shaft is 19 tons.

The cylinder is, of course, steam jacketed and cased as usual. The valve gearing is of the most improved kind, and for the purpose of gaining room, the exhaust chest is on one side of the equilibrium pipe, which is central. The exhaust pipe is carried through a trough supplied with cold water from the condensing cistern. There are two cataracts, one being applied to regulate the opening of the equilibrium valve. The steam arm passes through a slot in the (single) plug-rod, and is shut by a curved tongue piece, whose position is controlled by a regulating screw, of length sufficient to give the requisite variation in cutting off. The valves are opened by weighted pistons moving air-tight in cylinders on the cataract floor. The air pump is 26 inches diameter, 5 feet stroke, dipping into the condenser, and having in its bottom a grating carrying a circular gum foot valve. The bucket valve is also of gum; the delivery valve a cast iron float faced with wood. The injection valve is provided with a "wing throttle," opened and closed with the exhaust. The vacuum attained is 28 inches. The condenser and greater part of the air pump are immersed in the condensing cistern, and covered with water. A balance bob is on the surface connected to the main rod.

Steam is furnished by three single flue boilers, 6 feet diameter, 26 feet long, set below ground level. The flue is 45 inches diameter, containing at the firing end the grate, which is 6 feet 9 ins. long. The heated gases passing first through this flue, return at the sides to the front end, descend and pass under the bottom with the connecting flue to the chimney. This connecting flue contains a heater 30 ins. diameter, 28 feet long, through which the feed water passes before entering the boilers. Over the front end is a steam drum 30 inches diameter, 13 feet long, connected by pipes to stop-valves in each boiler, and from which rises the main steam pipe. The boiler shells and flues are of three-eighth-inch best Pennsylvania plates. The heads are of half-inch plates.

The chimney is 4 feet square in the flue, 70 feet high.

The feed water is supplied from an adjacent spring by a steam pump, the Mine water being too much impregnated with mineral substances.

This engine has been erected upon one of the deepest vertical shafts on the concern, which is 770 feet deep. The pit-work consists of three plungers and one drawing lift, each 10 feet stroke; the whole of them are of the same size bore, being 14 ins. diameter, as all the water accumulates to bottom. The main rod is of Pennsylvania pine; the first, 240 feet from nose of the bob, is 16 ins. by 14 ins.; the next 240 feet is 14 ins. square; and the remaining 240 feet is 12 ins. square—thus

making the entire length of main rod 720 feet. These rods are joined together by scrap-iron strapping plates 16 feet long, with 16 screw-bolts in each plate, and each joint having 4 plates. These rods are supported the whole length in guides (or stays) not exceeding 30 feet distant; these guides are of wood, 7 ins. by 10 ins., fastened into the wall of the shaft, and are held together by screw-bolts and iron glands, which at any time can be easily adjusted. At each set of those guides the main rod is protected by thin hard wood linings, and held to the rod by quarter glands screwed. Each plunger pole is screwed to the main rod by eight strong iron staples and glands, with a filling piece of wood 9 inches thick—the upper end of the stock works through a set of guides similar to those on the main rod. The main rod has four sets of catches, 3 of these on the down stroke and one on the up stroke of the engine, which prevents the whole machinery traveling beyond a given length of stroke in case of accident.

The foundation for each plunger consists of ten pieces of pine 12 ins. deep, fastened into the walls of the shaft in front of the main rod. And at one side of the rod cross timbers are again built upon these, four feet wide and five feet deep, fitted very snugly together, constituting fifteen feet of solid timber under the cistern, thereby preventing any spring or motion in the plunger or column on the turn stroke of the engine.

The stuffing-boxes are packed partly with Russian yarn and partly with gum; either of these alone was found not to answer so well.

The construction of the clacks introduced here, are what are commonly called the Gribble clack, consisting of a cast iron shell or lid, 1½ ins. thick, having a hinge which works upon a pin or bolt, supported by two loops fastened to the outer part of the seating. This hinge lifts about 2 ins. in the loops at every up stroke of the water. The shell has a groove one inch and a quarter deep by one inch wide all around, shaped to the face of the seat; in this groove four slips of sole leather are fastened on their edge, leaving a projection of ¾-inch for a beat upon the seat. The water ways through these clack seats and throughout the entire columns are the same in diameter as that of the plungers. Some of those clacks have been at work over six months without being re-geared.

This engine was started to work towards the latter part of last May, and in a few months drained the mines some 300 feet to the present working level, and the raising of coal has been resumed with vigor.

The usual speed in draining, was from 5 to 7 strokes per minute. At present the mine is kept clear by working at 4½ strokes about one day in six.

This is the first *pumping* engine of the kind which has ever been erected in this State. She works in admirable order, and for material and workmanship reflects great credit to the builders. The Company are moreover entitled to great credit for the foresight shown in providing in the erection of this engine a surplus power which will enable them to extend their operations to almost any extent. The hoisting engines are of the ordinary kind of high pressure, and coal is raised

by the cage and guide rods, with 4-wheel boxes which carry half a ton of coal in each box, and when at full speed it is estimated to raise sixty of those boxes per hour with each engine.

In view of the wide extent of territory, the superb machinery erected, and other facilities for making large and profitable returns, this Company may congratulate themselves as only on the eve of doing a wide and profitable business for many years to come.

AMERICAN PATENTS.

List of American Patents which issued from October 5 to October 26, 1858, (inclusive,) with Exemplifications.

OCTOBER 5.

1. Steam Boiler Furnaces; James Alcorn, Jr., Charlestown, Massachusetts.

Claim—1st, The arrangement of the chambers with their respective passages communicating with the smoke-stack, and the passages and the chamber communicating with the ash-pit. 2d, The arrangement of the cone pipe with its deflecting cover and the pipe, in combination with the chamber arranged in rear of, and communicating with, the ash-pit.

2. Gate; Silas Allington, West Dresden, New York.

Claim—The lever with its self-shifting weights, and its connexion to the gate, in the manner set forth.

3. Fly Trap; Bryan Atwater, Berlin, Connecticut.

Claim—As a new thing or manufacture, a fly-catcher, constructed with the notch or passage, arranged with respect to the upper edges of its side and two ends, and so as to operate substantially as described.

4. Animal Traps; Moses H. Biddle, Mount Carmel, Illinois.

Claim—The combination and arrangement of the pivoted bar, spring detent, and the spring catch. Also, the arrangement of the spring pulley, cord, and axis, of the revolving platform of a rat trap in combination, for the purpose of effecting a prompt revolution of the platform as soon as the detent is disengaged.

5. Rolling Window Blind; S. W. Bidwell, Hartford, Connecticut.

Claim—1st, So hanging the roller upon which the blind is hung, that it shall traverse in a horizontal plane (or nearly so), by means of the racks and toothed journals, or their equivalents. 2d, In connexion with the above, the combination with a rolling blind of a weighted cord, arranged with a helically grooved pulley on the end of roll, or in any other way substantially the same, for the purpose of counteracting the weight of the blind. 3d, The combination with the traversing roll of a weighted self-adjusting "friction fixture," consisting essentially of a weighted case and inclosed pulley. 4th, So arranging the tapes of a rolling blind with the shaft on which the slats are wound, that the slats may be shifted by the partial rotation of said shaft.

6. Slate Pencil Sharpener; William Burnet, City of New York.

Claim—The manufacture of a pencil sharpener made of inclined cylindrical rods having raised teeth upon them, either in the form of screw threads or sharp parallel ridges, and the attachment of these to any suitable plate or frame work of metal for securing the cylindrical bars or rods in their proper position, and for securing the whole to the frame work of the slate.

7. Screw Propeller; Oliver Byrne and J. G. Elliott, City of New York.

Claim—The device and method described, or their equivalents, for conducting useless or superfluous water to the rear of a screw propeller in immediate contact with the blades aft, not for the purpose of giving a rotary motion to the propeller, but for the purpose of diminishing what is termed "slip," by the operation and methods described.

8. Deflecting Plates for Circular Saws; J. D. C. Carpenter, Cincinnati, Ohio.

Claim—1st, The rotary deflecting plate or spreader, provided with an adjustable friction bearing, as set forth. 2d, The cutters placed near the margin of the deflecting plate, substantially as set forth.

9. Carpet Stretcher; W. S. Cowant, City of New York.

Claim—A carpet stretcher made by combining the clamp and wedge with the other necessary parts of a carpet stretcher, as set forth.

10. Lubricating Car Axles; John W. Cochran, City of New York.

Claim—In connexion with the spring and wheel, the inclined diaphragm, having the space for the play of the wheel, and access to the wheel and spring, as described.

11. Washing Machine; Samuel W. Cole, Millington, Maryland.

Claim—The combination of the lever, E, shaft, C, and hinged levers, b b, with each other and with the rubbers, for the purpose of moving said rubbers in contrary directions at the same time, and allow the upper rubber to rise and fall, to adapt itself to the clothes.

12. Cam for Throwing Bolts in Locks; Henry W. Covert, Rochester, New York.

Claim—The combination of the cone or wedge-shaped centre with the socket or outer rim, to form a cam for throwing the bolt to the lock.

13. Fog Signal Machines; Joseph D. Custer, Norristown, Pennsylvania.

Claim—The application to fog signal machines, magnetic telegraph registering machines, &c., of my improved retaining power, including pinion, I, wheel, J, shaft, K, pinion, L, wheel, Q, click spring, and balance piece, when arranged to form an adjustable and durable retaining power.

14. Knives to Cut Paper Bags, &c.; Henry R. Davis, City of New York.

Claim—The serrated knife having a vertical movement, in combination with the narrow slot in the bed plate for sustaining the paper while several thicknesses are being cut for bags or other irregular forms, as set forth. Also, forming said serrated knife with alternate long and short serrations, for piercing and cutting several thicknesses of paper.

15. Railroad Switch; Charles C. Dodge, Marshall, Michigan.

Claim—The application and use of the combined arrangement of the grooved or threaded cylinder, lever, guide pin, pivoted target staff, pin tie bar, and box, for the purpose set forth.

16. Folding Guides; Alexander Douglas, City of New York.

Claim—The peculiar flattened tube, folded upon itself, as described, so as gradually to fold the enclosed material along three lines, and at the same time to support it on all sides, and preserve its stiffness at all other points, substantially as described.

17. Carpet-Sweeper; Jacob Edson, Boston, Massachusetts.

Claim—1st, The arrangement described of hanging the brush at or near one of its journals in a bridle, and attaching the opposite end of the said bridle at a point on the case of the machine between the centre of the driving-wheel and the other journal of the brush, whereby the machine is made self-adjusting, so as to adapt itself to heavy or light sweeping. 2d, Attaching the handle of the machine to the bridle at a point near the driving-wheel instead of in the centre of the machine. 3d, Forming the entire machine of a tapering shape, as described, whereby the brush can work successfully in the corner of an apartment to be swept. 4th, The combination of the revolving brush, having the bristles arranged spirally thereon, with the tapering shaped dirt-receiver, so as to sweep and convey the dirt into the larger end of the receptacle. 5th, Combining in one the door for removing the dirt and the dirt receiver, by constructing it as described.

18. Steam Plough; James W. Evans, City of New York.

Claim—1st, The combination and arrangement of the main shaft and cranks, forming part thereof with the main axle and driving-wheels, by means of screw shaft, and the bevel, and the screw thread upon the axle, so that by the action of the piston rod attached to crank, the reciprocating action is communicated to the ploughs, and at the same time the machine is moved forward in due proportion to the stroke of the ploughs by the rotation of wheels, and thereby cutting a continuous furrow by a rectilinear and direct thrust of the plough or ploughs. 2d, The construction and arrangement of the supports or guide pieces, the pairs of vertical rods, operating by means of the eccentric, and the lever and arm, in the manner described, for guiding, securing, elevating, and lowering the plough.

19. Grain Cleaning Machine; W. T. Fisher, Cleveland, Tennessee.

Claim—The oscillating blast and screen spout, scourer, blast spouts, and fan, combined substantially as set forth.

20. Rolling Railway Iron; John Fritz, Johnstown, Pennsylvania.

Claim—So arranging of "three high" rolls for railroad rails, bars, or beams, as that said rails, bars, or beams may be rolled or reduced as they pass both forward and back, and so that each succeeding pass shall roll down the fire formed at the preceding pass, and avoid any necessity of turning the bar as heretofore done. Also, in combination with the top of the series, or with any roll of a series which performs its duty, the yielding clearer or guide, or its equivalent, for preventing the bar, rail, or beam from winding on said roll.

21. Cotton Scrapers; C. A. Gaines, Watson, Mississippi.

Claim—Giving a hollow or concave form to the bottom of the block from the rear and side edges inward, and forward to the mould-board or scraper.

22. Gas Metres; Joseph E. Fisk, Salem, Massachusetts.

I do not claim the employment of two flexible bellows in two separate chambers. Nor do I claim the mode of constructing the flexible bellows, as exhibited in the United States patent numbered 9591, wherein such bellows is made of two metallic shallow dishes or partitions joined at their edges by a flexible connexion. This differs essentially from my invention, wherein a sack, I or J, separate from and arranged within a flexible enclosing case, M or N, is employed, as in my invention the sack alone constitutes the gas-receiving chamber, and can be readily removed from its flexible case whenever necessary, without requiring the enclosing case to be removed from the metre.

Claim—The described improved arrangement of the partition, K, and the shaft, D, the cranks, valve, C, and valve seat, B, with respect to the chambers, E H and A, and the pipes or passages, a b c d, the same enabling one shaft, D, only necessary to the operation of the valve by the two sacks, I and J. Also, combining with each flexible sack, I J, a flexible enclosing case, M or N, arranged so as to operate therewith, as specified. Also, the arrangement and application of the pipe, F, with respect to the valve, C, and the case of the metre, the same being in manner and for the purpose as specified.

23. Hay Rakes; Peter Fitzgerald, Constantine, Ohio.

Claim—The combination of the shafts, and the clutch, and brake, with the levers, bar, handle, and cam, for the purpose of putting the brake and clutch in operation, as described.

24. Washing Machine; John Fordyce, Morgantown, Virginia.

Claim—In combination with the reciprocating plunger, the tipping rack, and the stationary rack teeth, the three parts operating together in the manner set forth.

25. Gearing for Cut-off Valves for Steam Engines; P. W. Gates, D. R. Fraser, and Thomas Chalmers, Chicago, Illinois.

Claim—Working the cut-off valves, D D, in combination with a main slide valve or separate main slide valves of the character described, by means of the pawls, k k′, to lock the cut-off valves with the main valve or valves in an open condition, the variable or adjustable slides, p p′, to disengage the said pawls, the stops, 3 3, to stop the said cut-off valves in a closed condition after their liberation, and stops, y y y y′, to stop and open them by the completion of the stroke of the main valve or valves.

26. SEWING MACHINES; Wm. O. Grover, Boston, Massachusetts.

Claim—1st, The combination of a cylinder, and plunger, and needle of a sewing machine, in the manner specified. 2d, A slot, or its equivalent, for the purpose specified, in combination with the guiding mechanism of a sewing machine needle.

27. SEWING MACHINES; Wm. O. Grover, Boston, Massachusetts.

Claim—1st, The combination with a curved needle or hooker-on, or looper, of an irregularly shaped spiral shaft and a reciprocating driver, both substantially such as before specified, and constituting an apparatus for imparting the required motions and pauses to a crooked needle. 2d, Mounting a driver, combined with, and acting upon, a spiral shaft, with a spring or springs. 3d, Combining such springs with layers of raw hide, leather, or similar material, when acting upon, and in combination with, a spiral shaft. 4th, An actuating surface, so formed as to surround or embrace an irregular screwed shaft, and at the same time free to slide in a driver, in planes perpendicularly, or nearly so, to such a shaft.

28. SEWING MACHINES; Wm. O. Grover, Boston, Massachusetts.

Claim—The combination of a spring, a bar attached to or making part of a slide and resting upon a cam, and a cam shaped substantially as specified, when these parts are held in working position and connexion by the spring, as there is no attachment between the bar and the cam, all these parts being substantially such as are before described, and acting severally and in combination, substantially in the manner specified.

29. SEWING MACHINES; Daniel Harris, Boston, Massachusetts.

Claim—Driving the needle arm and the apparatus for effecting the feed and for forming the loops in sewing machines, by means of a pulley provided with an india rubber ring, or its equivalent, and hung in brackets cast on to the bed plate, in combination with a fly-wheel also hung in brackets, but which are attached to the table, said pulley and fly-wheel being arranged in relation to each other, so that they may be readily thrown into or out of working contact, as set forth. Also, the peculiar construction of the hollow goose neck, when so shaped as to admit of the insertion of a bent needle arm, and the vibration thereof upon a fulcrum within said goose neck, in the manner specified. Also, for feeding the cloth, or other substance, in sewing machines, the feed hand connected by means of a yielding joint with the slotted plate containing the slide, and forming therewith a parallelogram opening in combination with a vibratory needle stock having a pin projecting into said slot, so as to operate in the manner described.

30. CARPET SWEEPER; Daniel Harris, Boston, Massachusetts.

Claim—The arrangement of a revolving brush driven by means of a padded driving-wheel from one side only within a semi-cylindrical casing, provided with stationary pockets and deflectors in front and rear of the said brush.

31. HALTERS AND BRIDLES FOR HORSES; S. C. Hawkins, Patchoque, New York.

Claim—Forming the ring with a flanch, and securing the straps to the ring by rivets, which pass through the straps and flanch.

32. MACHINE FOR CUTTING LATHS; Reuben Haynes, Oberlin, Ohio.

Claim—The arrangement of the curved slot and lever, in combination with the revolving sliding shafts and gears, when arranged as described, for the purpose of raising and giving a throw to the log conjointly, and acting with the immediate gearing, in the manner described.

33. CONSTRUCTION OF ANIMAL TRAPS; Edmund Hill, Cincinnati, Ohio.

Claim—The ridge or step, in combination with the door and lever, for the purpose of re-setting the trap.

34. BAGGAGE CHECKS; Edmund Hoole, Mount Vernon, New York.

I do not claim, broadly, stamping or engraving the names of the different stations on one plate or check, one at each side, for it is quite common to employ both sides of signs, slates, &c., for analogous purposes, and the mere employment of both sides of a baggage check for directory surfaces, even if practicable, would not be invention. Therefore, I

Claim—Stamping, engraving, or otherwise marking on the plate or check, A, the names of two different stations, one at each side, when said plate thus stamped or engraved is used in connexion with a strap, B, attached to the plate, and rendered capable of being adjusted as shown, for the purpose specified.

35. PACKING PISTONS FOR STEAM ENGINES; Hanford Horton, City of New York.

Claim—The application of the figure 8, or other appropriate spring, between the upper and the lower set of metallic cylinder rings, as described, by which an upward and a downward pressure is obtained on said rings. I do not claim the application of springs to produce an outward pressure, said springs acting on a single or spring ring which keeps out the two cylinder rings, as that has heretofore been in use by others as well as myself. But I do claim the combination of the six rings, a 1 2 3, b 1 2 3, with the figure of 8, or other appropriate spring, between them to produce an upward and downward pressure, in combination with the figure of 8, or other appropriate spring acting on the two spring rings, producing an outward pressure on the four cylinder rings, thus making a steam tight joint on the upper edge of the upper cylinder ring, as well as on the lower edge of the lower cylinder ring, and also on the cylinder surface of the cylinder rings.

36. PHOTOGRAPHIC BATHS: Bernhard Hufnagel, City of New York.

Claim—The construction of a silver bath for photographic and ambrotype purposes, made out of two plates of glass, with india rubber between, and fastened together between wooden or other frame work, in the manner described.

37. HEMP BRAKES; Wm. C. Hutchinson, St. Josephs, Missouri.

Claim—The tooth, described and illustrated in the drawings, as constructed, to be used in the drums of cylinder hemp brakes. Also, the combination and arrangement of the pendant scalloped edge swingle, with the sliding or reciprocating double jaw hatchel, arranged and operated substantially in the manner described.

38. HARVESTERS; G. F. and Moses Jerome, Mineola, New York.

Claim—The guard formed with an oblique portion, in combination with the seat placed relatively with respect to each other and the platform, as described.

39. VALVES FOR STEAM ENGINES; Joseph Jobin, St. Maude, France; patented in France April 13, 1858.

Claim—The sliding balance valve, constructed of a prismatic or partly prismatic form, and guided in its reciprocating travel by and within a steam chest open or closed at its ends, but surrounding in a close manner the sides of said valve.

40. APPARATUS FOR RAISING DOUGH FOR BREAD; Josee Johnson, City of New York.

Claim—The double brake, in combination with the conical shield, operating as described.

41. BALLET-BOX; S. C. Jollie, City of New York.

Claim—The employment of a glass globe in the construction of a ballot-box, by mounting the globe as described, so that it shall be simply held in place without concealing the contents, and having a hole at top of sufficient size for the hand, which hole is to be provided with a hinged cover with a hole of the required size to drop the ballots through.

42. CARD CLOTHING; Richard Kitson, Lowell, Massachusetts.

Claim—Constructing the teeth, so that when in place their points are below or less prominent than, and protected and guarded by, their thick parts or heels.

[This invention consists in so forming the pointed teeth of "card clothing" for cotton gins and wool-burring machines, that when the clothing is wound upon a cylinder or fastened to an endless belt, the points will be below the thick parts of the wires, and the thick parts of the wires will form smooth surfaces for the feeds or burrs to roll upon, and thus prevent them from coming in contact with, and being broken by, the points, and also the teeth from being damaged. By this intervention the only objection to the use of toothed surfaces for ginning cotton and burring wool, namely, the breaking of the seeds or burrs, and the liability of damaging the teeth are overcome.]

43. WATER ALARM FOR STEAM BOILERS: Levi E. Lincoln, Lowell, Massachusetts.

Claim—1st, The application of an alarm whistle exclusively to the water space of a steam boiler to obtain controlling motive power, in conjunction with an application exclusively to the steam space of said boiler, to obtain warning or acoustic power. 2d, The application of a self-adjusting valve to the stem of a steam whistle, in manner such that a current may be intercepted thereby. 3d, The application to a whistle of a metallic tube or pipe, in such manner that unexpanded it shall be pendant from the whistle, and that by expansion and contraction it shall have the office to effect the operation of the whistle. 4th, The application of a set-screw, or mechanical equivalent, to an expansive tube, in such manner that the effective expansion and contraction of said tube may be prescribed thereby. 5th, The application of a whistle to its support, standard or frame work, in such manner that the whistle shall be suspended from said frame work by that portion of itself which extends upward from its bell. 6th, The holding of a valve seat in position for its valve by pendulous attachment by suspension. 7th, The operating of a valve seat upon its valve by the expansion and contraction of a metallic tube, or by the expansion and contraction of any mechanical equivalent thereof.

44. SPARK ARRESTERS; Joseph Marks, Boston, Massachusetts.

Claim—The combination of the petticoat pipe, the surrounding wire net work, and the smoke pipe, whereby, while a free exit passage is secured for the exhaust steam, an intermittent draft is produced upon the outer surface of the wire net work, which pulverizes the sparks and retains them until they are consumed, as set forth.

45. MODE OF TRANSMITTING MAGNETIC SIGNALS ON RAILROADS; Henry Maule, Philadelphia, Pennsylvania.

Claim—Securing to a railroad a series of conducting rails independent of those of the track, and placed in pairs, one pair being disconnected from the next pair throughout the series, and each pair of conducting rails being arranged to connect with a galvanic battery on the train by the devices described, or their equivalents, one rail of each pair to one pole and the other to the other pole of the said battery, and the latter being connected to any suitable indicating apparatus situated on the train, as set forth.

46. BANK LOCKS; L. H. Miller, Providence, Rhode Island.

Claim—1st, A series of slotted sliding tumblers within a sliding box, arranged in such relation with the bolt or bolt latch, that each tumbler will require to be adjusted separately, in order to allow the bolt to be shoved back, and the lock unlocked. 2d, The arrangement of the hollow arbor, rod, lever, and tube, with projection attached, in connexion with the notched disk and click, and a key, constructed as shown, or in an equivalent way, whereby the tumbler box is moved the correct distance for the several tumblers to be brought in line with the projection, and the several tumblers adjusted at each movement of the box. 3d, Operating the sliding tumbler box from the arbor, by means of the part pinion and the rack of the plate, arranged in such relation with the dogs, slide, and bolt, that by the time the tumblers are all properly adjusted, the dogs will respectively raise the latch and throw back the bolt.

47. CULTIVATORS; B. S. Morgan, Delhi, Iowa.

Claim—The arrangement of the bars with share stocks attached, the levers with links fitted in the triangular shaped openings in said levers, and attached to the coulter bars which are connected to the levers. Also, in combination with the above, the brace rods, attached to the share stocks by means of the springs, and fitted in the recesses in the stocks.

48. TRIP HAMMER AND ANVIL; D. A. Morris, Pittsburgh, Pennsylvania.

Claim—The arrangement of a gang of trip or tilt hammers in connexion with the movable anvil, constructed in the manner specified.

49. ROLLS FOR MAKING SHEET IRON; D. A. Morris, Pittsburgh, Pennsylvania.

Claim—The employment of mottled chilled iron rolls for rolling sheet iron, when constructed as described.

50. DISTILLATION OF FRESH WATER FROM SALT WATER; A. Normandy, London, England, a citizen of France.

Claim—The process set forth, by which ærated and non-ærated fresh water are obtained by distilling sea water.

51. STEAM WATER TANK; S. H. Yocum and J. O. Byrne, Shelbyville, Indiana.

Claim—1st, The extension of pipe, B, above the bottom and inside of tank, A, in combination with valve, C, and gauge, U, or their equivalents, in the manner set forth. 2d, The flexible pipe, D, and stop cock, c 2 and M, in combination with the plexus, o o, and air-tight tank, A, as set forth.

52. APPLE-PARING KNIFE; Adam Oat, Minetto, New York.

Claim—The combination and arrangement of the curved blade with its projecting end, and the guard or stock, as specified.

53. WINDLASS FOR MOVING CARS AND LOCOMOTIVES WHEN WITHOUT STEAM; Charles Page, West Meriden, Conn.

Claim—The combination of the windlass with the jaws and the levers, when arranged, and made to produce the result, by the means and in the manner described.

54. TOOLS FOR MANUFACTURING GOODS OF CAOUTCHOUC; D. D. Parmelee, City of New York.

Claim—The instrument or tool for cutting sheets of india rubber, or its equivalent, constructed substantially as described, consisting essentially of two jaws provided with cutting edges shaped according to the form

intended to be produced, when one jaw is to operate within the other so as to effect shear action, for cutting forms at one stroke and leaving edges thereon, which are capable of being united in a more perfect and expeditious manner than has ever been done heretofore.

55. HAY RAKES; M. Raezer, Reading, Pennsylvania.

Claim—The spring bar, the foot lever, and the gearing, arranged as described.

56. WATER INDICATOR FOR STEAM BOILERS; M. Robbins and J. L. Frisbie, Cincinnati, Ohio.

Claim—1st, In the described combination with a customary steam alarm, the steam pipe, provided with a central screw, stem, and swivel, supporting the fulcrum of the float arm, in the manner set forth. 2d, In this connexion, we claim the small steam dome inclosing the branched pipe, valve, and lifter, substantially as set forth.

57. MACHINES FOR CUTTING ROOT GRAFTS; S. S. Rockwell, Vermontville, Michigan.

Claim—The arrangement of the shanks, and blades, and movable blades, in the manner specified.

58. CARPET SWEEPER; Stephen P. Rowell, Reading, Massachusetts.

Claim—In combination with the brush and its main operating gear, devices for adjusting the brush and maintaining its axis at the same or at its proper distance from the axis of the gear, in order to maintain the gear in engagement with its pinion, as specified. Also, the application of the rear dust receptacle to the frame, so as to be capable of being swung or turned upward and outward therefrom, for the discharge of dust.

59. COOKING BOILERS FOR RANGES AND STOVES; Joseph Schmadel, Dayton, Ohio.

Claim—A cooking boiler, provided with perpendicular tubes or flues around its sides, from the bottom upward, and opening into a horizontal flue or chamber around the top of the boiler, for the blaze and smoke to pass through.

60. TICKET HOLDERS; Ira W. Shaler, City of New York.

Claim—The combined construction and arrangement of the body, holding bar, spring, and catch, substantially as set forth.

61. WRAPPERS FOR CIGARS; James S. Suter and George M. Palmer, Baltimore, Maryland.

Claim—Taking pearl ash, powdered sal ammoniac, lobella or Indian tobacco, oil of anio seed, oil of caraway, alcohol, grass, rope, rum, cascarilla bark, opium, sumac, and stems or refuse tobacco, and converting it into sheets for wrapping woolen goods to prevent moths from eating them, lining for cases for the same, covering for carpets, and wrappers for cigars or tobacco.

62. APPARATUS FOR TANNING; A. C. Taggart and Alexander Gray, Alleghany, Pennsylvania.

Claim—1st, The arrangement of pivot, y, and links, x, as herein described. 2d, The use of the pipes, n, when placed near the top of the vats, and used in connexion with the pipe, o, as described.

63. MANUFACTURE OF CANDLES; Joel H. Tatum, City of New York.

Claim—Coating or covering candles manufactured of tallow or other inferior substance, with a plurality of compositions formed of stearic acid and tallow in varying proportions, together with proper fluxes to give different degrees of fusibility, and also certain degrees of hardness and smoothness to the same, substantially as described, the candles being dipped into the several compositions in the order of the sequences.

64. LINING FOR COAL STOVES AND FURNACES; Wm. B. Treadwell, Albany, New York.

Claim—The employment of hollow blocks of metal, filled in with siliceous sand, as a new article of manufacture, to be used as a substitute in the place of fire-brick for the lining of the fire chambers of stoves and furnaces, substantially as set forth.

65. MACHINE FOR NUMBERING THE PAGES OF BOOKS; Edward and Calvin E. Town, Jersey City, New Jersey.

Claim—The use of type blocks containing a limited number of types, constructed as described, with the ratchet teeth at the side, or any equivalent device to secure their uniform motion. Also, the level bed pieces, as described, in combination with type blocks. Also, the mode of delivery of the type blocks, by means of the discharge boxes, as described. Also, the general combination of these parts with each other, and with the other parts of the machine.

66. SLIDES FOR SKIRT HOOPS; Wm. M. Warren, City of New York.

Claim—The slide composed of the two parts, formed as specified, and combined by a lock between the lapping portions of the hoop.

67. MACHINE FOR TRIMMING THE EDGES OF PAPER HANGINGS; John Waugh, Elmira, New York.

Claim—Rotating, concave, self-sharpening circular knives, whose shafts do not revolve in the same line, but at an angle to each other, giving the knives a pressure against each other, at the point of contact only—the reverse sliding motion of hopper and reel spindle, in combination with wooden roller, pulleys, and band and hand crank, in the manner set forth.

68. APPARATUS FOR MANUFACTURING FATTY ACIDS; M. Werk, Cincinnati, Ohio.

Claim—The combination of boiler superheating furnace and tank, for the production of fat acids, without distillation or direct application of fire, as set forth.

69. FURNACES FOR HEATING BUILDINGS; John Plant, Assignor to self and George H. Plant, Washington City, D. C.

Claim—The mixing of all the heated products of combustion both below and above the fire cylinder, by an arrangement of diving and ascending flues leading into common chambers, where they cross each other, and are forced to commingle, substantially as described.

70. COTTON GINS; A. Q. Withers, Byhalia, Mississippi.

Claim—The curved spring board situated in the "roll box," and provided with teeth projecting from its lower edge, arranged as specified. Also, the employment of the additional brush and carding saws, situated between the ginning saws and discharging brush, and acting in combination therewith substantially as described. In combination with the additional brush and carding saws, I claim the concentric screen and "break currents," when arranged in close proximity to said brush and saws, and for the special purposes set forth, in connexion with their action.

71. ROACH TRAP; Alexander N. Shell, Assignor to Wm. S. Wood and Thomas N. Shell, Richmond, Virginia.

Claim—The centre bait pan, in combination with the annular ring, when located as shown.

72. HAY RAKES; George Whitcomb, Port Chester, New York.

Claim—The arrangement of the treadles, lever, rake head, arms, bar, joints, and adjustable rope, substantially as set forth.

73. SEED DRILLS; W. Irvin Willitts, Milton, Indiana.

Claim—The arrangement and combination of the corrugated roller, the adjustable frame, receding drill ploughs, the supporting chains, and the hooks, all arranged as described.

74. MACHINE FOR STAMPING TRADE MARKS ON CLOTH, &c.; Algernon S. Wright, Lawrence, Massachusetts.

Claim—The arrangement and combination of the reciprocating carriage or table, the stamping mechanism, the inking apron, and its vat or trough, as made to operate together substantially in manner as described. Also, the combination of the stamp connexion bar and the spring, as applied to the lifter rod and the stamps. Also, the peculiar means or combination for operating the stamps, viz: a mechanism for lowering them gradually toward the apron, a mechanism for allowing the stamp to fall by the force of gravity upon or toward the table, mechanism for elevating the stamp off the table as well as off the apron, as described, and mechanism for maintaining the stamp at rest during each movement of the bed or carriage, the whole being in one cam as applied to a lifter bar, as described.

75. ICE PITCHER; James H. Stimpson, Baltimore, Maryland, executor of James Stimpson, deceased, late of said Baltimore, Maryland.

Claim—The treble wall for ice pitchers, as set forth.

76. MACHINE FOR CROZING, CHAMFERING, AND BEVELING BARRELS; Wm. M Arnall, Assignor to self, O. P. Smith, and A. C. Jordan, Sperryville, Virginia.

Claim—Not the employment of several tools, but the arrangement of the adjustable croze and howel blade, with the stationary beveling blade and chamfering tool, when the same are constructed and operated in the manner specified.

77. CONSTRUCTION OF AQUARIA; John Chilcott and James Scrimgeour, Assignors to selves and George F. Taylor, Brooklyn, New York.

Claim—The combination of the dovetailed tenons or tongues, and acute angular plate sliding over the same, with the outer triangular plate and ends of the plates of glass for forming a space or well between the same for the reception of the cement, and thus enabling a perfect water-tight joint to be formed at the corner of aquaria and other vessels.

78. MACHINE FOR PLANING WOOD; C. B. Cottrell, Assignor to self and Nathan Babcock, Westerly, R. I.

Claim—The rotating cutters and central stationary gauge, in connexion with an adjustable gauge, or its equivalent, arranged to operate as set forth.

79. ARTIFICIAL LEATHER; Wm. K. Hall, West Hoboken, New Jersey, Assignor to Amos Broadnax, St. Louis, Missouri.

Claim—The combination of the chemical constituents of leather, or their equivalents, substantially as described, for the purpose of forming a substitute for leather.

80. SEWING MACHINES; Joseph E. Hendrick, Assignor to self, W. H. Nettleton, and George Stevens, Bristol, Connecticut.

Claim—The shears, handles, or bowls, in combination with the upper part or blade acting as a needle carrier, and the lower part formed as a bed, whereby the sewing and feeding mechanism is actuated by a motion of the hand similar to that of cutting with shears, as set forth.

81. ROLLERS FOR CALICO PRINTING; John Hope, Assignor to self and Thomas Hope, Providence, R. I.

Claim—The copper shell, cast metal foundation tube, and with a mandrel connexion cast in the metallic shell or tube, and on an arbor or mandrel, in manner and of a material substantially as described.

82. SEWING MACHINES; Joseph White, Troy, New York.

Claim—Giving the looper its motions for catching, spreading, and holding open the loop, and then delivering it up to the needle without putting any twist in the thread, by means of a shaft having two motions at the same time, and given to it by mechanism, substantially as described.

83. MACHINE FOR FORMING BARRELS, &c.; Jacob Rees, Assignor to Jonah L. Rees, Elkhorn Grove, Illinois.

Claim—The construction of the cylinder, with the radial arms, and segmental parts, and disks, the circular clamps, and guide bands, the suspension devices arranged and operated as described.

84. RAILROAD CAR SEATS; Draper Stone, Milwaukie, Assignor to self and E. S. Turner, Grafton, Wisconsin.

Claim—1st, Providing the back frame of the high back seats with hinged cushioned frames at different or the same points of elevation, and jointing the front ones of them to horizontal bars secured to the back frame, and attaching and combining therewith bracing or supporting bars and slotted bars, in which their curved ends move in such a manner as to enable the said cushioned back frames to be folded together with the back frame between them, to form comfortable and distinct reversible seats, or raised and extended to the high back seat frame next in advance to form sleeping berths or couches on different horizontal planes. 2d, The combination and arrangement of the double hinged cushioned back frames of the low back seats, with and in the relation to the double hinged cushioned bottoms, curved bar, and spring notched bars attached thereto, and horizontal ledges or ribs on the sides of the uprights of the frame, substantially in the manner set forth. 3d, Giving a greater elevation to the hinged cushioned double back and bottoms of the low back seats, by combining therewith the pins or studs on the edges of the former lugs or projections in which they rest, and rock shaft, and bars or arms attached thereto, and spring notch bars, and lugs or projections in which they rest, and rock shaft, and bars or arms attached thereto, and spring notch bars, and lugs or projections on the high back seat frame next in advance.

85. GAS BURNERS; Junius F. Tozer, Assignor to George W. Gregory, Binghampton, New York.

Claim—The application to the common gas burner of the two or three way turning cock, for the purpose set forth.

86. SAW-GUMMER; Harvey R. Wolfe, Assignor to self, David Staples, and W. H. Watson, Consolation, Ky.

Claim—The arrangement and combination of the stone, adjustable beams, screws, slots, and carriage, as set forth.

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87. REVOLVING FIRE ARM; Thomas R. Austin, City of New York.

Claim—1st, The main spring attached to or formed on the trigger, whereby the pull on said trigger strains the main spring, as set forth. 2d, The sliding centre pin, I, shield, H, pin, H', and toggle joints, when com-

bined with the latch for disconnecting the pin, I, as described. 3d, The double-acting spring, fitted and acting as specified, to return the sere and trigger, and parts attached to their quiescent position.

88. HOT AIR COOK'S STOVE; Joseph M. Babcock, Albany, New York.

Claim—The combination of the double top, the perforated side plates, and the elevated oven, the same being arranged in the manner described.

89. METHOD OF ADJUSTING WINDOW BLINDS; W. H. Babcock, Homer, New York.

Claim—The sliding spindle or arbor for alternately engaging the two mechanisms which severally move the slats and open the shutter, so as to operate either mechanism by the same handle.

90. GAS BURNERS; Yarnall Bailey, Philadelphia, Pennsylvania.

Claim—The mode of producing a flame, the extent of which may be increased or diminished at pleasure, by means of the adjustable heater, in connexion with the tube and the burner, as described.

91. WATER CLOSET; Frederick H. Bartholomew, City of New York.

Claim—1st, The use of a drip box or leak chamber, arranged above the closet and below and around the supply cock. 2d, Arranging the supply cock upon the cover of the closet, whether the drip box be employed or not. 3d, The adjusting screw, the cam, and the lever, or the equivalent thereof. 4th, The laterally adjustable standard, substantially as described.

92. HINGE; Mathias Bettinger and August Boos, Cincinnati, Ohio.

Claim—The described arrangement and combination of the lugs and horns, for the purposes set forth.

93. GRAIN DRILLS; Samuel Binkley, Dublin, Indiana.

Claim—The slide, in the described combination with the grooved or corrugated staple, for the purposes set forth.

94. CAR COUPLINGS; George S. Bishop, Washington City, D. C.

Claim—The loop bolt or pin, B, in combination with the slots, H and I, and slide block with grooves. Also, the manner of supporting the loop bolt, by allowing the short arm to rest on the bumper head, as N, instead of resting on a block or ball, whether the slots, H and I, be separated or connected, when constructed in the manner set forth.

95. ESCAPEMENT FOR TIME-KEEPERS; Josiah Bishop, Austin, Texas.

Claim—The combination of the lever, springs, and the detents formed on the former, arranged in the relation to the escapement wheel described, with the pallets and said escapement wheel, so as to enable the balance wheel to perform its oscillations without pressure from the motive power of the clock, or to be retarded by any other resistance except that necessary to be overcome by the vibrations of the detent lever, during the action of the pallet on the end of the spring, as set forth.

96. MACHINES FOR DRESSING STONE; Wm. Cooper, Mount Gilead, Ohio.

Claim—The arrangement of the picks, screw, springs, and shaft, with the adjustable carriage, ratchet wheels, and ratchet, the same being constructed in the manner specified.

97. CULTIVATORS; C. H. and S. E. Carrington, Weymouth, Ohio.

Claim—The arrangement and combination of the side wings and bars with each other, and in relation to the frame, in the manner specified. Also, the mode of actuating and adjusting the hoes, by means of the wheels, stirrups, bar, lever, and catch plate, arranged in combination and acting upon the handles of the hoes, substantially as set forth.

98. MACHINE FOR PEELING WILLOW; George J. Colby, Waterbury, Vermont.

Claim—The vibrating rollers, in combination with the rollers, comb, and apron, or its equivalent.

99. HARVESTERS; George E. Cooper, Baltimore, Maryland.

Claim—1st, The combination of the straining bar, finger tube, and adjusting screw, with the arms upon which the cutting blade is mounted, for the purpose of keeping the cutter, which is made thin and without stock, under constant tension. 2d, Combining the lever of the shifting clutch with the lever for raising and lowering the cutting apparatus, in the manner described, so that when it is necessary to stop the motion of the cutter, the act of depressing the lever performs the three-fold duty of raising the cutter, stopping its motion, and the motion of the raking mechanism, as described—I do not claim, however, either of these levers, separately considered, nor the functions they perform.—3d, The arrangement of the raking mechanism consisting of two hands, which open as they advance over the platform on each side of the cut grain, and close as they recede, to form the cut grain into a sheaf, and deliver it at the rear of said platform, substantially as described.

100. MACHINE FOR SWEEPING STREETS; Amzi Crane, Newark, New Jersey.

Claim—1st, The brush or sweeping frame, being so adjusted that when the machine is in operation, the weight of the said frame is supported, as much as may be required, at its corners, upon the springs in the posts, and is free to conform to the uneven surface of the ground either as a whole or at any of its corners. 2d, The endless band or chain of brushes, when said band or chain of brushes is operated, for the purpose of depositing the sweepings in a row, by means of the grooved rollers, or their equivalents, into which the blocks of the brushes or the links of the endless chain are made to fit. 3d, The combination together of the driving wheel, the beveled wheel, with the pulley, belt, M, rollers, Z Z, and the endless band or chain of brushes. 4th, The combination of the cross-bar with the lever, D, crank, H, levers, K and L, with their appropriate connexions, and the chains for elevating or lowering the brush frame, and throwing the machine into or out of gear, substantially in the manner described.

101. CIRCULAR SAWING SHINGLE MACHINE; Jonathan Creager, Cincinnati, Ohio.

Claim—1st, The feed rest tangential to the saw at the end toward which the saw cuts, and having a motion parallel to the plane of the saw. 2d, In this connexion the feed rolls and their accessories, constructed to elevate the feed rest by power under control of the operator. 3d, The use in this connexion of the elastic fingers, as set forth.

102. SEWING MACHINES; Chauncey O. Crosby, New Haven, Connecticut,

Claim—1st. The combination of the cloth holder with the needle bar and thimble bar, when constructed as described. 2d, The combination of a needle bar and thimble bar with a common needle, when made to operate as described. 3d, The combination of the feeding apparatus with the needle bar, for carrying the needle, when made to operate as described. 4th, The combination of the needle bar with the hooks and endless tapes, when arranged substantially as described.

103. GRINDING AND POLISHING KNIVES; James Dodge, Waterford, New York.

Claim—The method of grinding and polishing articles, and forming their surfaces upon a revolving grindstone or polishing wheel, by attaching them to a drum or cylinder, which is made to revolve in the same direction with the stone or wheel, and with velocity adjustable thereto. Further, the method of attaching and supporting upon a curved surface of the article to be ground, so as to permit it to rock thereon, thereby shaping the surface when formed either flat, concave, or convex, substantially as set forth.

104. FASTENINGS FOR SKIRT HOOPS; Alexander Douglas and Samuel S. Sherwood, City of New York.

Claim—The combination of the link or loop, c, with the clasp, B, having an opening in its side to receive and retain one prong of said loop, and with the hook, substantially as set forth.

105. PORTABLE BOXES; A. Dreyspring, Montgomery, Alabama.

Claim—Constructing boxes capable of being folded and unfolded, without thereby impairing their shape or their usefulness, substantially as described.

106. MACHINE FOR CROSS-SEAMING SHEET METAL; Lucian Fay, Cincinnati, Ohio.

Claim—1st, In connexion with a cross-seaming tool, the gange bar, constructed as set forth. 2d, The grooved roller, constructed as explained, and employed in connexion with a cross-seaming tool to roll up the metal as joined, and afterward discharge the roll without unwinding. 3d, The adjustable guides, in combination with a seaming tool, for the purpose of insuring accuracy of work.

107. CONSTRUCTION OF IRON RAILINGS; Wm. S. Fuller, Millbury, Massachusetts.

Claim—The application and arrangement of ring segments or segmental connexions and their sockets, made substantially as described, to fence palings, and a connexion rod, the same being to effect advantages in the construction of metallic fences.

108. PEN-HOLDER; Josee Johnson, City of New York.

Claim—The thimble, A, with incision, C, when formed of one piece of metal and applied to the pen stock as a pen-holder.

109. SEWING MACHINES; J. E. A. Gibbs, Mill Point, Virginia.

Claim—In combination with an eye-pointed needle vibrating up and down and back and forth in a plane passing through the line of feed, the spring hook, or a hook constructed so as to yield sidewise or laterally of the path of the needle, when actuated by said needle in the manner described.

110. SEWING MACHINES; Wm. O. Grover, Boston, Massachusetts.

Claim—1st, Driving or speeding up a sewing machine by means of a convex elastic face on one wheel or pulley, acting in combination with and by friction upon a non-elastic concave face on another wheel or pulley, combined and acting together substantially in the manner specified. 2d, Supporting and steadying a sewing machine by the combination of a tube of india rubber, or its equivalent, with an internal pin or projection, the two being fitted and acting substantially in the manner set forth.

111. WATER WHEEL; Wm. H. Harbaugh, Piquia, Ohio.

Claim—1st, The peculiar arrangement of the bucket, in combination with the projecting annular float. 2d, The peculiar form of the bucket with reference to the percussion plate, all arranged in the manner set forth.

112. SELF-CLOSING DOOR; J. C. Harkness, Washington City, D. C.

Claim—The ball projecting through the socket in the bridle, and falling into a socket in the plate in the sill, in combination with the weight, cord, and pulleys, the whole arranged substantially in the manner set forth.

113. TANNING; B. Harrington and N. Russell, China, Maine.

Claim—The use of comptonia aspenifolia or sweet fern in room of bark, or any other tanning material now in use.

114. CENTRIFUGAL PUMPS; Wm. C. Hibbard, West Roxbury, Massachusetts.

Claim—1st, In the construction of the fan-wheel, the combination of the curved guide plate with the vanes, arranged around a central open space, substantially as described, and working in connexion with the covers and casing, or such other equivalent devices as will co-operate with it upon the same principle. 2d, I do not claim the spiral passage of discharge constantly enlarging toward its exit, to receive the accumulated discharge from the fan-wheel, as that has before been used—but, in combination with the centrifugal pump, I claim the expanding outlet constructed upon the principle described, whether employed in combination with the spiral passage of discharge or applied directly to the fan-wheel. 3d, Constructing the casing of a centrifugal pump with a detached cover, in combination with the fan-wheel and fixed casing, as described.

115. WATER WHEEL; J. P. and D. W. Hoyt, Lumber City, Pennsylvania.

Claim—The combination of a wheel, as constructed, with the casing, as constructed, when the two are so arranged that the water will be received on the broad backs of the buckets, and be discharged by their inclined fronts between the casing and the shaft of the wheel, in the manner specified.

116. INDEX OR BOOK-MARKER; Josee Johnson, City of New York.

Claim—The clasp, made of one piece of metal, with the angle between its points for receiving the leaf, while the clasp is applied in a vertical position, or nearly so, and opening to receive the leaf as it is pressed against its edge, and firmly grasping the leaf when applied.

117. TOOL FOR CHAMFERING SOLES FOR BOOTS AND SHOES; Wm. Johnson, Hampstead, New Hampshire.

Claim—The tool, as constructed, with means not only of adjusting the angular position of the knife with respect to the sole rest, but the distance of the said edge at the gauge from the rest, as described.

118. APPARATUS FOR PRESERVING MALT LIQUORS; John Keane, City of New York.

Claim—The diaphragm or bag of india rubber, or other similar flexible material, of a form to fit simply to half of the cask or other vessel, and attached all round the middle of the same, so as to operate in the manner described.

119. TRUSS PADS; L. B. McLain, Sr., New Lisbon, Ohio.

Claim—Constructing pads for trusses for hernia or rupture of solid blocks of half cones with plane and curved faces, as set forth.

120. STIRRUPS; John Loudon and H. Iverson, City of New York.

Claim—Constructing a stirrup with a joint at or near the centre of the sides, substantially as specified.

121. Box for Carriage Wheels; R. W. McClelland, Pekin, Illinois.

Claim—In combination, a hub box with an interior groove and flanch, as represented, the peculiar manner of constructing and placing upon the spindle the spindle boxes or bearings, so as to properly fit into the above described hub boxes.

122. Constructing Frames for Wire Cloth Paper-making Cylinders; J. and R. McMurray, City of N. Y.

Claim—The spiral wire or rod and longitudinal rods, connected to suitable heads provided with journals in connexion with the spiral wire, the whole being arranged as set forth.

123. Knitting Machines; J. K. and E. E. Kilbourn, Norfolk, Connecticut.

Claim—The transferring of stitches in a knitting machine from the needles on which they have been formed to other needles, by means of transferring hooks, or their equivalents, which take the stitches from the needles, move along to other needles and deliver the stitches to these other needles, operating automatically. Also, arranging transferring hooks with reference to the needles, in such manner that they may enter the stitches upon the needles by moving along the stems of the needles toward their heads. Also, directing the operation of transferring hooks, or their equivalents, for transferring stitches by means of a pattern barrel, or its equivalent, operating as set forth. Also, combining the mechanism that actuates transferring prongs with the mechanism that moves the needles of a knitting machine, in such manner that the prongs enter the stitches upon the needles at times when the latter are supported both vertically and laterally. Also, combining a nosing having V-shaped grooves with transferring prongs having corresponding grooves, the grooves of the nosing and prongs acting in concert to confine the needles and direct their heads into the stitches on the transferring prongs. Also, controlling the operation of the mechanism by means of which the relation of the thread guide to the needles is changed, so that yarn is supplied to more or less needles by means of a pattern barrel, or its equivalent. Also, varying the extent of travel of the needle carriage in proportion to the number of needles at work, by means of mechanism operating automatically. Also, varying the periods of time at which the mechanism begins to operate in proportion to the number of needles at work, by means of mechanism operating automatically. Also, combining the widening mechanism with the mechanism that actuates the needle carriage, in such manner that the period of time at which the former operates is varied in proportion to the number of needles at work. Also, combining the mechanism that actuates the pattern barrel, or its equivalent, with the mechanism that actuates the needle carriage, in such manner that the period of time at which the former is moved is varied in proportion to the number of needles at work. Also, combining the widening mechanism and the narrowing mechanism together, when both are used in the same machine, in such manner that the movement of the one to do its work is attended by a corresponding movement of the other, so that the thread guide and transferring hook, or their equivalents, are both *in* the proper position to operate in connexion with the selvage needle. Also, raising the sinkers out of the way of the prongs of the transferring instrument, substantially as set forth, so that the latter may move along the series of needles without obstruction from the sinkers. Also, obtaining a pause in the endwise movement of a nut moved by a screw, by causing the screw to move endwise while it is turning in the nut. Also, the arrangement of the pattern holes by a pattern barrel in a helical line, so that they may be brought in succession beneath the device upon which the pattern pins operate by a screw, or its equivalent. Also, operating the transferring instrument, substantially as set forth, in such manner that its movement is effected partly while the carriage is traveling in one direction, and partly while it is traveling in the opposite direction. Also, combining with a traveling series of needles and a rigid bar above them, stationary under supports over which the needles ride, so that their barbs may be closed by pressure against the stationary bar above them.

124. Gas Regulators; Wm. Mallerd, Bridgeport, Connecticut.

Claim—Arranging the graduating lever, 4, with the adjustable weight, 17, in combination with the reservoir, 2, and the valve, 10, in such a manner that by raising the reservoir the valve is closed and the supply of gas stopped, so that the pressure of the reservoir can be regulated by adjusting the weight, 17. And in combination with the lever and reservoir, I claim admitting the gas to the reservoir by means of a small tube, 8, which is contracted toward its upper end, so that impurities carried up by the gas are deposited outside of said tube without being able to interfere with the working parts of the gas regulator. And, further, arranging the stud, 21, in combination with the lever, 4, rod, 9, and valve, 10, in such a manner that by depressing the stud, 21, the supply of gas may be ascertained without raising the cover of the regulator.

125. Cultivators; T. M. Lee, Broad Ford, Virginia.

Claim—So combining the cylinder, R, stock, H, and block, O, with their respective teeth, with each other, and with the main frame, as that they can individually or severally be adjusted for deeper or shallower work.

126. Machine for Chamfering and Crozing Barrels; J. H. Mattison, Scriba, New York.

Claim—A crozing tool provided with two spurs, one before the other, to cut the sides of the croze or score, and a hook or grooving tool to cut the bottom of the score, when the whole is made or formed of a single piece of metal, substantially as described. Also, the use of the solid shaft and hollow shaft, in combination with the pulleys, or their equivalents, which operate them with different velocities, when used for the purpose of giving motion to the chamfering and crozing tools, or their equivalents, and for moving or carrying them (the chamfering and crozing tools) forward to perform their work in chamfering and crozing barrels, in the way and manner described.

127. Paper Clamps; Arnold Palmer, Lee, Massachusetts.

Claim—The pressure box placed over the bed and attached to the lever through the medium of the bar, lever, and adjusting rods, actuated by the nut or tube, f, the above parts being arranged to operate as shown, and with or without the spring catch.

128. Portable Water-proof Friction Match Safe; Platt Merrill, Sanilac, Michigan.

Claim—The lever, B, provided with the spring or yielding slide, C, the plate, F, having the spring, G, and guides, r r, for retaining the matches in place, and the arm, E, provided with the corrugated spring catch, D, the whole being arranged within and connected to the case, A, substantially as set forth.

129. Machines for Separating the Fibre from the Pulp in Hemp Leaves; S. S. Mills, Charleston, S. C.

Claim—1st, The toothed cylinder, H, concave, C, provided with the steam or water pipe, S, and reciprocating bar, D, provided with the clamp, E, arranged for shredding the hemp. 2d, The vibrating toothed plates, Q Q, in combination with the reciprocating clamp bar, L, and steam or water pipes, R R, for the purpose of heckling the hemp. 3d, The cylinder, H, provided with the longitudinal plates, e, and the concave, I, provided with the loaded plates or flaps, J, for the purpose of skutching the hemp or separating the pulp from the fibre. 4th, The combination of the tooth cylinder, E, concave, C, toothed plates, Q Q, clamp bars, D L, cylinder, H, and concave, I, provided respectively with the plates, e J, substantially as specified.

130. Manufacture of Sheet Iron; David A. Morris, Pittsburgh, Pennsylvania.

Claim—The manufacture of enameled anti-corrosive sheet iron by the process specified.

131. Compound Shell for Ordnance; L. B. Olmsted, Binghampton, New York.

Claim—Surrounding an explosive shell with a number of chambered segments, each charged with cartridges or other projectiles, and discharged by fuses properly connected with the inner exploding shell, the whole forming a second or outer spherical shell, arranged in the manner set forth.

132. Manufacture of Fire Bricks; J. Ostrander and J. S. Heartt, Troy, New York.

Claim—The manufacturing of fire bricks, tiles, or blocks of a composition consisting essentially of pulverized steatite or soapstone raw fire-clay (with or without kaolin), and a fire sand ground "biscuit," or both, the ingredients being mixed in the ratio specified, or in any other available proportions, as set forth.

133. Life Preserver; Hiram Palmer, Augusta, Michigan.

Claim—The arrangement of the folding frame, the metal chambers, B B, the provision chamber within said chambers, B B, the flexible air chambers, and the propeller, the whole being combined in the manner specified.

134. Mowing Machines; Fisk Russell, South Boston, Massachusetts.

Claim—Attaching the cutters to hubs or bosses which are fitted on pins in the finger bar, and provided with arms which are fitted in notches in the cutter bar, the bosses, arms, and bar, being covered by a plate, substantially as set forth.

135. Compositions used as Building Materials; N. C. Raymond, Austin, Texas.

Claim—The application of pasture-fed cow dung, either in substance or solution, together with lime, either slacked or unslacked, or other powerful alkaline substance, and charcoal, to the common clays or soils of the country, for the purpose of producing a building material, substantially as described.

136. Horse Shoe Machine; T. H. Russell, Northfield, and Amos Morrill, Strafford, Vermont.

Claim—The movable former and lateral forming rollers, arranged with the guide rollers and grooves the vertical pressure roller and the female die, when combined as set forth. Further, the particular arrangement of the roller bar, G, to wit: having said bar provided with the rollers, *i' i'*, which bear against blocks, j j, attached to the uprights, H H, and having the pin, h, pass through an oblong slot, g, in the upper part of the bar, substantially as set forth.

137. Construction of Cylinders and Pistons for Pumps and Steam Engines; Wallace Wells, City of N. Y.

Claim—The improved mode described of constructing the cylinders, pistons, and their connexions, for steam engines, and applying steam thereto, and of constructing the cylinders, pistons, and their connexions, in fire engines, pumps, and other machines using cylinders and pistons.

138. Method of Lighting Street Lamps by Electricity; Charles W. Smith, Evans, New York.

Claim—1st, The combination and arrangement of a circuit changer with different circuits of conducting wires, in which are included a number of street lamps, in such a manner that the lamps in one circuit only may be lighted simultaneously by means of the battery current. 2d, The combination of conducting wires with devices for operating by electricity such a circuit changer at a station remote from the operator. 3d, The arrangement of the magnet, the brass plate, the lever, and the pawl, substantially as described.

139. Rotary Planing Cutter; John Sperry, City of New York.

Claim—1st, A plane formed of a series of thin plates, said plates being in form of a cima-reversa, or other form approximating thereto, and placed side by side one another on a revolving axis or shaft, and confined in place by means of a screw nut. 2d, Having the central portion of the several sections of the plane at back and front, run at right angles to the axis of the plane, substantially as set forth.

140. Mode of Reversing the Chisel in Mortising Machines; Frederick Stamm, Lancaster, Pennsylvania.

Claim—The arrangement and combination of the devices, substantially as described, for the purpose of reversing the chisel whilst in operation.

141. Rule for Describing Polygonal Forms; Merriwether J. Thompson, St. Joseph, Missouri.

Claim—The construction, use, and application of a mitre bevel gauge formed with an arc of a circle whereon are described various given tabular numbers, so as to indicate by fixed lines, angles, or dots, any required mitre line indicating its respective polygonal shape and measurement (without describing and subdividing a circumference), but through means of corresponding tabular numbers, substantially in the manner set forth.

142. Farm Gate; Joseph A. Treat, Talmadge, Ohio.

Claim—The levers, G H, in combination with the lever, E, and link, e, said parts being applied to the gate, arranged and connected by the chains, substantially as described.

143. Manufacture of Sugar; J. C. Tucker and L. Lanzweert, San Francisco, California.

Claim—The process of decolorizing and defecating saccharine liquid and vegetable juices, and application in the manner described of hydrated alumina—cream of alumina—prepared as set forth.

144. Cultivators; W. Tucker, Blackstone, Massachusetts.

Claim—The combination of the rotary toothed drum, of rotary series of teeth, with a set of stationary gird bars and teeth projecting therefrom, the whole being arranged, applied to a frame, and constituting a new or improved cultivator or agricultural implement, to operate substantially in the manner specified.

145. Steam Generator; Ferdinand C. Warlick, Kentish Town, England; patented in England, March 9th, 1858.

Claim—The arrangement of the water heating coil of pipes, within flues leading from the fire-place, and through or about the steam generator, when such water heating pipes terminate in foraminous pipes extending into the steam generator, so as to discharge the heated water into it in fine jets, or spray, or mist, as described. And, in combination with the coil containing the flue within the generator, and the flues about the ends, and cylindrical outer surface of the generator, I claim the flue space directly beneath the coil flue, and arranged within the generator, as described. Also, the arrangement of the side flues, the two bottom flues, and single top flue of the generator, in combination with the arrangement of the water heating pipes extending through the same, and with the coil flue and fire-place, as represented.

146. Seeding Machines; Andrew Simmons, Nora, Illinois.

Claim—Forming the seed slide of a corrugated plate, and making the seed openings therein at the edges and on opposite sides of the ridges or corrugations, substantially as set forth.

147. Elastic Stair Pad; Thomas J. Mayall, Roxbury, Assignor to self and Benj. F. Cooke, Boston, Mass.

Claim—The above described "Elastic Stair Pad," of the composition and form substantially as set forth.

148. WATER WHEEL AND CHUTE; Alden Whitman, Auburn, Maine.

Claim—The peculiar form of the bucket in conjunction with the corresponding form and relative position of the spout thereto, in the manner described.

149. HARVESTERS; John Woody, Mount Vernon, Indiana.

Claim—1st, Placing the reel between arms which have their back ends pivoted to the machine, and their front ends connected with the eccentrics on the shaft, by means of the yokes, as set forth. 2d, The roller attached to the upper part of the wing or divider, as set forth.

150. LOOMS FOR WEAVING HAIR CLOTH; Samuel B. Chaffee (for self and as administrator of Samuel M. Chaffee, deceased), Providence, Rhode Island.

Claim—1st, Forming the selvage of hair cloth by means of a set of headles operating independently of the headles used in forming the rest of the cloth, as described. 2d, The method described of operating the jack staff by the combination of the cams, I I', rods, K K', lever, M, and rod, N, as specified.

151. RACK FOR HOLDING COMB MATCH CARDS; E. G. Byam, Boston, Mass., and B. E. Parklaurst, Brunswick, Maine, Assignors to Ezekiel Byam, Charlestown, and S. A. Carlton and E. G. Byam, Boston, Mass.

Claim—The arrangement and combination of the frame, bars, spring, and screws, as described.

152. COTTON GINS; Lewis S. Chichester, Assignor to Henry G. Evans, City of New York.

Claim—The saws, in combination with the oscillating breast, the parts being constructed as set forth.

153. CANS FOR PRESERVING PAINTS; Edward Clark, Assignor to Wm H. Dolson, City of New York.

Claim—Attaching and securing the heads to the sheet metal body of the can or keg, by forming a projection round the interior near each end of such body, in the manner described, for the heads to rest against, and turning the edges of the body over the heads after the insertion of the latter, substantially as set forth.

154. COATING METAL; Selah Hiler, Haverstraw, New York, Assignor to John M. and Cornelius A. Berrian, City of New York.

Claim—The coating iron or steel with copper, silver, or brass alloys, where silver or copper is used, by bringing the iron or steel, while in a melted state, into contact with the coating metal, and allowing them to so remain until the two metals have become hard by cooling, substantially as specified.

155. SPELLING BLOCK; Samuel L. Hill, Assignor to Albert Palmer and Sidney Doane, City of New York.

Claim—1st, The arrangement of letters on any number of six-sided blocks, in the manner described. 2d, Giving to and placing upon each block its proper numerical figure, for the purpose specified.

156. CORN ERADICATORS; Corydon Wheat, Geneva, New York.

Claim—The corn eradicator, constructed as described, as an article of manufacture.

157. HARVESTERS; John K. Harris, Allensville, Indiana.

Claim—The rocking pinion with cogs, p and p', adapted to yield, as explained, when passing the ends of the wheel cogs, or on the backward motion of the drive wheel.

158. SEWING MACHINES; Warren Millar, Assignor to self and John Nutt, Chicago, Illinois.

Claim—1st, The revolving hooked ring, constructed as described, when arranged and operating in combination with the needle and the reciprocating spool, carrying the locking thread, for the purpose specified. 2d, The loose ring applied within the rotating two hooked ring, and operating in combination therewith, substantially as described, to produce a tension on the locking thread.

159. PUMPS; Henry W. Regan, Cressona, Assignor to self and George H. Newer, Harrisburg, Pennsylvania.

Claim—Combining with the water ways of a double-acting pump and air chambers divided by a partition, so that each of the water ways shall have its own air chamber, but the water from each to be transmitted into a common chamber before its exit from the pump, substantiailly as set forth.

160. BREECH LOADING FIRE ARM; John P. Schenkl, Worcester, Assignor to self and Edward A. Dana, Boston, Massachusetts.

Claim—In combination with the bore or chamber of a fire arm or piece of ordnance, a secondary and smaller fire arm or barrel arranged within it, substantially as described. I do not claim a conical tige, as used in the "carabine a tige," and for the purpose of spreading a ball. But I claim the conical or tapering spreader or end of the tige, in connexion or combination with the chamber within the tige, and to operate in the manner as specified. Also, the improvement of the chambered tige or secondary barrel, as made with a cutting front end, and particularly as made with a serrated end. Also, the arrangement of the touch-hole of the hollow tige in the breech screw thereof, in such manner that when the breech screw is in place in the main barrel, not only shall its touch-hole communicate with that of the main barrel, but the breech screw shall intercept all communication of the touch-hole of the main barrel with the bore or chamber of such main barrel, except through the touch-hole and bore of the secondary barrel. Also, the improved combination of tige that is with the base of the spreader, made of greater diameter than the neck or part of the tige which is immediately below it, the same being for the purpose as set forth.

161. SPADING MACHINES; Judd Stevens, Assignor to self and John L. Beadle, Marengo, New York.

Claim—Jointing or hanging the spade to the wheel, in such a manner that in the forward motion of the machine, it will remain in proximity with the periphery of the wheel until the lifting of the earth commences, when it shall pass outwards or slide upon its bearing, thereby acting more efficiently to raise and disintegrate the soil. Also, the combination and arrangement of the tripping lever with the spade, substantially as described.

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162. EXTRACTION OF VOLATILE OILS, &c., FROM COAL; Luther Atwood, Brooklyn, New York.

Claim—1st, The gradual and progressive formation at a comparatively low temperature of oleaginous vapors and oil from coal, or other substances yielding pyrogenic oils, by the gradual and progressive action of the heat of products of combustion upon and through the mass. 2d, The immediate removal of the oleaginous vapors and volatile products of decomposition from the point of formation away from further action of the heat conducing to, and resulting from, their production, through the remainder of the mass and apparatus, by means of a properly regulated current of products of combustion. 3d, Condensing the liquid volatile products of distillation within the body of the distilling tower, and during the continuous distillation of the solid materials, substantially as described. 4th, Obtaining crude oil from coal, and other solid substances yielding pyrogenic oils, by the combined and successive operation of the above mentioned methods of treatment.

163. SKELETON SKIRTS; E. G. Atwood, Derby, Connecticut.

Claim—A skirt formed of tape, or other similar material, and a series of circle hoops, when the tape is passed over one hoop and under the next below it, in opposing oblique directions, and the tapes fastened at the points where they interlock on the hoops themselves, by clasping, sewing, or tying, substantially as set forth.

164. SEEDING MACHINES; A. G. Babcock, Galesburgh, Illinois.

Claim—The described arrangement of the form rollers, grooved cylinder, elastic wipers, hopper, guide plate, drags, and windlass, when constructed as set forth.

165. COFFEE POTS; Nelson Barlow, City of New York.

Claim—The tubular condensing vessel in its specified arrangement, when cold water is used in the same, and the discharge is graduated in the manner described.

166. GAUGE FOR CONTENTS OF CASKS, &c.; John K. Barney, Warren, Rhode Island.

Claim—The double rods with arms, tubes, and index, as described, and their combination in the instrument, by which the cask is measured in length and diameter outside or inside, in manner set forth, and the construction of the tables with slides, by which is found by inspection the mean diameter, the proper allowance for thickness of staves or head, and the quantity of contents of the cask, from the given or ascertained admeasurement.

167. COMPOSITION FOR PAINTS; James K. Beardsley, City of New York.

Claim—The composition of matter to be used alone as a white paint, or in admixture with pigments for colored paints, as set forth.

168. MODE OF OPENING AND CLOSING FARM GATES; Wm. T. Boggs, Cincinnati, Ohio.

Claim—The grooved cylinder or cam actuated by the loaded pawl arm, and used in connexion with the lever and arm. Also, in combination with the cylinder or cam, pawl arm, lever, and arm, the drop latch, arranged with the levers, k, l, so that the latch may be operated automatically, as described.

169. MANUFACTURE OF WROUGHT NAILS; Otis Breden, St. Louis, Missouri.

Claim—1st, The die faces, constructed and fitted as described, operated in connexion with the slides, the crank, and the cams. 2d, The use of the bar for moving out the arm and the spring, for forcing in the chisel which is attached to the arm, to cut off the nail. 3d, The attachment of the rod to the crank working the feed gearing, causing the rollers to revolve and feed the iron from the furnace into the die faces. 4th, The employment of the header wheel and the operation of the rods attached to the crank, for moving the same around in order to bring the nail opposite the header die. 5th, The employment of the beader die with the slide, for the purpose of forming the head, together with the pawl for holding up the slide, and the motion of the cam in lifting the trigger of the pawl, leaving the slide free to be forced in to head the nail by the spring.

170. POSTS FOR CLOTHES LINES; Benjamin Chesnut, Philadelphia, Pennsylvania.

Claim—The post with its row of inclined teeth, and its roller and pawl, and the brackets with their rollers, when the several parts are combined as set forth.

171. ARRANGEMENT OF MEANS FOR MAKING TIGHT JOINTS AROUND THE FAUCETS OF WATER COOLERS; John S. Clark, Philadelphia, Pennsylvania.

Claim—The projection, ring, and cap, as an arrangement of means for allowing of the making of a perfect joint, as described.

172. CUT-OFF VALVES FOR STEAM ENGINES; Benjamin Bunce, City of New York.

Claim—Combining with a slide valve of ordinary character, a cut-off valve, constructed substantially as described, that is to say, the slotted tube, secured in a fixed position upon the slide, said tube having its ends so closed that the steam shall pass to the valve through the slots, and having also upon it a cylinder slotted in like manner capable of being revolved thereon, so that the opening and closing of the slotted passages shall be effected by the action of the slide valve itself in carrying the cut-off to and from the stops set to intercept the revolving cylinder, as set forth.

173. LIQUID GAUGE; Erastus T. Bussell and Joseph Smith, Cincinnati, Ohio.

Claim—The double spring valve composed of valves, springs, and rod, or their equivalents, combined with a measuring faucet, as described.

174. CARPET SWEEPER; Augustus C. Carey, Ipswich, Massachusetts.

Claim—1st, Placing the revolving brush at the extreme front of the box, and hanging it in adjustable bearings. 2d, The deflector, operating substantially as described. 3d, The combination of the revolving brush, the double pulley, or its equivalent, and the roll, when so arranged that the brush may be disconnected from the roll and be operated by hand, substantially in the manner specified.

175. LUBRICATOR; Elias Clampitt, Baltimore, Maryland.

Claim—The peculiar construction of my valve and the introduction of hollow tube into stem (in connexion with valve), with its openings and flanch below, acting as a valve against the lower end of shaft, supplied with a spiral spring at top, producing thereby a self-acting valve, when the pressure on cup is removed, as described.

176. MANUFACTURE OF SHEET IRON; Josephus Chandler, Attica, Ohio,

Claim—Coating or covering bars, plates, or sheets of iron, or either of them, before, at, or during the manufacturing process of heating and rolling with clay, iron ore, or other mineral matter, salts, and also with the chlorides or other compounds of zinc, tin, &c., or of their mixtures with other mineral matter, for the purpose substantially as set forth.

177. HAMMERS; Josiah P. Clark, Portland, Maine.

Claim—The combination with an ordinary hammer of the metallic plate with an opening and slide, constructed substantially as set forth.

178. HORSE COLLARS; C. K. Cuckler, Columbus, Ohio.

Claim—The combination of the breast plate, E, springs, D D, side plates, a a, and springs, c c, when the whole are arranged in the manner specified.

179. MACHINES FOR LIFTING HEAVY WEIGHTS; T. J. Davis, Scroepell, and J. B Warner, Volney, New York.

Claim—The combination of lever, D, operating horizontally, and lever, C, moving parallel to each other

in a line with the fulcrum, and catching alternately into ratchet, n, as they are made to reciprocate by the vibrations of lever, D, as described.

180. HAMMER HEADS; Rufus Dawes, Washington City, D. C.

Claim—A hammer head, with its face inclined to the longitudinal axis of the head, in the manner set forth.

181. PLOUGHS; John Dickson, New Castle, Pennsylvania.

Claim—The use of a double movable landside for increasing the size and weight of the plough, in the manner described.

182. MARINE PROPELLER; John Eaton, Belleville, Canada.

Claim—Propelling boats by means of paddles or vanes rotating in, and surrounded by, a casting provided with an aperture or apertures near the centre to receive the water, and with a radial spout for the discharge, when such rotating vanes or paddles and surrounding case are placed at the stern, and outside the boat or vessel, substantially as described. Also, making said case which surrounds the paddles or vanes so that it can be turned to place the discharge spout in any desired direction relatively to the plane of the keel, for the purpose of propelling the boat or vessel either forward or backward without reversing the direction of the propeller, and also for steering or turning, as set forth.

183. PADDLE WHEEL; H. Ehrhart, Muscatine, Iowa.

Claim—The described system of lever-like arms, carrying the floats pivoted to the body of the wheel, and combined with each other by the floats and rods, and operating substantially as described, in combination with the guides.

184. HARVESTERS; Rosewell H. Fisher, Claremont, New Hampshire.

Claim—1st, The combination of the connecting rod, e, slide bar, c, eccentric wheel, d, rod, f, and lever, g, with the cutter, k, for the purpose of throwing said cutter bar in and out of gear. 2d, The arrangement of the plates, h, the cutters, i i i, the slotted wheels, n n n, and the cutter bar, k, with the fingers, j j, the same being conjoined and constructed in the manner described. 3d, Securing the reel, H, to the wheels, J J, when it is operated and adjusted by the means set forth.

185. FURNACES FOR TEMPERING STEEL; Perry G. Gardiner, City of New York.

Claim—1st, The heating of steel for the purposes of preparation, for hardening, tempering, or annealing in a closed chamber or oven of fire-brick, or other suitable material, impervious to the flame, smoke, and gases of combustion—the smoke, flame, and gases of combustion being distributed over the exterior surface of the floor, roof, and rear of the heating oven, by means of vertical and return or reverberatory flues between the fire chamber and chimney. 2d, The perforated air tube placed at the foot of the vertical descending flues on the side of the bridge wall opposite the fire-place, in combination with the fire chamber and flues, and between the fire chamber and oven, operating in the manner set forth.

186. PHOTOGRAPHIC SHIELD; Ebenezer Gordon, City of New York.

Claim—The corners formed with two recesses, and applied at the angles of a square frame to receive the photographic plate, or its equivalent, in a horizontal or vertical position, as set forth.

187. WRITING TABLE; Jacob S. Haskill, Salem, Massachusetts.

Claim—The arrangement of the circular bolt with, and for fastening of the several drawers, substantially as specified.

188. STAVE JOINTER; William Halderman, Freeport, Illinois.

Claim—The combination of the rotating conical cutter heads and the polygonal feed wheel, arranged for joint action substantially as set forth.

189. APPARATUS FOR MAKING GLASS STOPPERS FOR BOTTLES, &c.; Thomas R. Martell, Philadelphia, Penna.

Claim—The block or die with its vertical recesses, in combination with the spindle, its grooved disk, and the radial punches, when the whole are arranged substantially as set forth.

190. SEWING MACHINES; George W. Hubbard, West Meriden, Connecticut.

Claim—Operating the looper by means of a pin working in conjunction with the needle, in the manner substantially as described.

191. CONSTRUCTION OF METALLIC SIDE PAVEMENTS; Peter H. Jackson, City of New York.

Claim—The combination of the tie rods and brackets formed on the under sides of the plates, with the staunchions acting to connect said plates to each other, straighten said plates, and strain the said tie rods, substantially as specified.

192. BOTTLES FOR CONTAINING MERCURY; Isaac G. Johnson, Spuyten Duyvil, New York.

Claim—The mercury bottle formed and composed of malleable cast iron, substantially in the manner set forth.

193. WATER GAUGES FOR STEAM BOILERS; J. Johnson and R. Lapham, City of New York.

Claim—The hollow plugs with conical stem fitting into the glass tube, and the elongated hole or passage, in combination with the screw for adjusting the plugs, operating as described.

194. HOISTING JACKS; William Kearney, Newark, New Jersey.

Claim—The combination of the screw shaft, two or more concave faced worm wheels, two or more worms of different threads, the journals of the worms in eccentrics, two nut cases or boxes with an adjustable crank, in the manner specified.

195. RE-SAWING MACHINE; William D. Leavitt, Cincinnati, Ohio.

Claim—The combination of the yoked feed rollers and clamps extending up to or near the perimeter of the saw, for the purpose of feeding through and pressing out all the warps or bends in the board or plank, and holding them so pressed out until the same acts substantially as described. Also, the combination with the yoked feed rolls and clamps, operating together as described, the auxiliary feed rolls to receive and feed in the next succeeding board or plank without affecting the action of the other rolls on the plank or board being sawed.

196. HOOP SKIRTS; George Mallory, Watertown, Connecticut.

Claim—The construction of one or more of the hoops or springs of a skirt, with elastic pieces, or their equivalents, arranged one on each side so as to provide for flexure of said hoop or hoops over the edge of a

seat, when its or their back parts are sat upon, without impairing their flexibility, in an upward and downward direction of any other parts than those where the flexure is immediately required, substantially as described.

197. MAIZE HARVESTERS; C. B. Matthews, Oquawka, Illinois.

Claim—The saw and stationary cutters, in combination with the revolving arms attached to shafts, when the several parts are arranged to operate as set forth. Also, in combination with the above, the sliding bars or slats connected with the lever, and arranged with the opening in the platform, as described.

198. BEDSTEAD; Rufus Maxwell, Tucker County, Virginia.

Claim—The construction and arrangement of the end rail with the notch, the side rail with the tenon, substantially as described.

199. COMBINED MOP AND BRUSH; Henry McClay, Niles, Michigan.

Claim—The tri-lateral block or head attached at one side to the handle, and having a brush formed on one of the other sides, the remaining side being corrugated and having a cloth attached, the whole being arranged as set forth.

200. FIELD FENCE; John B. Mitchell, Wayne, New York.

Claim—The combination of the slotted post with the panels, when constructed with the slides and auxiliary battens, so as to form a fence readily convertible from a straight to an angular one, substantially in the manner set forth.

201. ROLLS FOR PLANISHING IRON; James Noble, Monongahela Borough, Pennsylvania.

Claim—The use of rolls having a straight groove, depression, or recess extending parallel to its axis for the entire length of the roll, or at least for the length of the other roll of the pair into which the other roll is placed before they are pressed together, for the purpose of securing a degree of pressure adequate to the planishing of single sheets of metal, in the manner described.

202. COFFEE ROASTERS; C. J. C. Peterson, Davenport, Iowa.

Claim—The application of a damper, constructed and operating substantially as set forth, to the drum of a coffee roaster. Also, the spring catch and block, in connexion with the sliding door of the drum, constructed as described.

203. PLOUGHS; Wm. Reaney, Berzelia, Georgia.

Claim—1st, The mode of varying the form of the plough by the use of the adjustable coulters, the latter being provided with the sub-soiler, and the several parts constructed as set forth. 2d, The use of the wedge, in combination with the mould-board for adjusting the entire front part of the mould-board to correspond with the adjustment of the coulters, as described.

204. RAKING ATTACHMENT TO HARVESTERS; A. R. Reese, Phillipsburgh, New Jersey.

Claim—The combination of the vibrating arm, the rake, the link piece, and the crank, when the several parts are constructed substantially as described.

205. CLASPS FOR METALLIC OR OTHER FLEXIBLE BANDS; Albert C. Richard, Newtown, Connecticut.

Claim—The use of frame, a, and ring, b, in combination with band, c, substantially as described.

206. BURGLARS' ALARM; H. R. Robbins, Baltimore, Maryland.

Claim—The manner specified of combining and arranging relatively to each other on a door and door frame, or other structure, the alarm movement, cap nipple, exploding spring hammer, and stop or set pin, for the purpose set forth.

207. SEEDING MACHINES; Marshall S. Root, Medina, Ohio.

Claim—The bent arms, Q Q, arms, P and U, rod, O, and spring, R, when these several parts are arranged as described, for operating the corn planter and sower, and combined with the revolving harrow, as set forth.

208. METHOD OF OPENING AND CLOSING FARM GATES BY APPROACHING VEHICLES; E. C Rowland, Phelps, New York.

Claim—The connexions described of the levers and the endless chain, as connected with the gate, for the purpose of forming self-opening and shutting gates.

209. SUBMARINE EXPLORER; Van Buren Ryerson, City of New York.

Claim—The method of controlling the rising and sinking power of the apparatus, by means of a reservoir or reservoirs of compressed air, connected and combined with a working chamber or chambers, and rising or sinking therewith, so that the operators within, by the use of the compressed air, can readily control the rising and sinking power of the apparatus without communication with the surface. Also, a submarine explorer, in which the rising and sinking power is controlled by a reservoir or reservoirs of compressed air, making part thereof, and rising and sinking therewith, and in which there are two or more working chambers, the dividing the said working chambers by a hatchway, which can be closed water and air-tight to sustain the apparatus with the top above water, when said top is open for any purpose, as set forth. Also, in combination with the reservoir or reservoirs of compressed air, connected and combined with one or more working chambers, and rising and sinking therewith, the employment of one or more ballast chambers at or near the bottom, and so arranged that at the will of the operators they can be made to communicate with the compressed air reservoir or reservoirs, and with the surrounding water to increase the lifting or sinking power of the apparatus, as set forth. Also, in a submarine explorer, combining with the working chamber or chambers thereof, the employment of a spray or shower of water, which at the will of the operators inside may be discharged at any time required to purify the air by absorption. Also, in combination with the reservoir or reservoirs for compressed air, combined and moving with one or more working chambers, the employment of a pump which can be worked by the operators within, and which communicates with the reservoir or reservoirs of compressed air, and also by means of a flexible pipe and float provided with a self-acting valve with the atmosphere above, so that in case of accident the operators within can replenish the air in the reservoirs to enable them to control the apparatus, as described.

210. METHOD OF APPLYING ELECTRICITY DURING EXTRACTION OF TEETH; J. S. Sinnmerman, Glassborough, New Jersey.

Claim—Applying electricity to the gums or teeth, or both, during the operation of extracting teeth, by means of the insulated adjustable spring clip described, or its equivalent, the said clip being connected to one of the poles of an adjustable electro-magnetic machine, or its equivalent.

211. HARVESTERS; J. D. Smith, Lancaster, Ohio.

Claim—Having a horizontal joint in and near the centre of the reel frame piece, substantially as set forth.

212. UMBRELLAS; Henry Steele, Jersey City, New Jersey.

Claim—The combination of a lock with a closing catch of an umbrella, for the purpose specified.

213. MACHINE FOR CUTTING STAVES FROM THE BOLT; Wm. Steele, Wheeling, Virginia.

Claim—1st, The use of an apron hinged to the bed plate, as described, or otherwise attached to the machine in such a manner that it can be held under or back of the knife to support the piece during the process of cutting, and then swing down or fall back to allow the piece to drop from the knife. 2d, The combination of the levers and stops, as described, or their equivalents. 3d, My improvement to be applicable to machinery for cutting steamed wood, for any or all of the purposes for which it is now (or may be) cut.

214. CULTIVATORS; T. S. Stevens, Pepperell, Massachusetts.

Claim—The combination of a set of vertical stripping cutters and a set or series of revolving under surface cutters, applied to operate together, substantially as specified.

215. HYDRANTS; James Swan, Brooklyn, New York.

Claim—The use of the elastic tube, in combination with the metal or rigid tube, for the purpose of excluding water from the entire length of the hydrant, when arranged substantially as described.

216. PAPER FEEDER FOR PRINTING PRESSES; Lemuel T. Wells, Cincinnati, Ohio.

Claim—In the described connexion with the cylinder of a printing press, the vibrating frame bearing the nippers and opposing bar, and operated substantially in the manner set forth.

217. NUT MACHINES; S. H. Whitaker, Cincinnati, Ohio.

Claim—1st, The die-box and punch, or their equivalents, operating as set forth, so as to embody the greater portion of the wad or core in the nut or bar, while confined on all sides save one, in the act of punching. 2d, The arrangement of the punches, dies, and perforated bridge, or equivalent devices, operating together substantially in the manner described, for the automatic and economical manufacture of hot-pressed nuts.

218. DEVICES FOR ADJUSTING TO A RIGHT ANGLE THE JOINER'S SQUARE; L. Yale, Jr., Philadelphia, Penna.

Claim—Extending an arm, or its equivalent, to act as a lever along the handle or stock far enough to insure the proper effect of the adjusting screws, or their equivalents, for the purpose and substantially as described.

219. BANK LOCKS; S. S. Burlingame, Assignor to self and Wm. Taylor, Warwick, Rhode Island.

Claim—One or more pairs of spring slides to close the key-hole, provided with pins to enter the notches and lock the collar or working key, the slides being so constructed as to be pushed open by the point and bits of the key when it is inserted as described. Also, the collar or working key, in combination with the pawls, so constructed and arranged as to be pushed out by the bits of the key, when it is inserted as described. Also, closing the key-hole and locking the working key by the sliding tube or collar, pushed out by a spring and locked in the key-hole by the bolt, as described. Also, fastening the working key to the back plate of the lock by means of a flanch and plate, substantially in the manner described.

220. MANUFACTURING CAR WHEELS OF CAST IRON; G. S. Bosworth, Assignor to Anson Atwood, Troy, N. Y.

Claim—The employment of highly heated "chills," when combined with sand moulds, in the manner set forth.

221. LATHE FOR CUTTING SCREWS FROM WIRE; George W. Daniels, Assignor to self and Abraham Fuller, Waltham, Massachusetts.

Claim—Combining with a lathe arbor devices made and applied to it, substantially as described, so as to enable rods varying in diameter to be securely clamped and centered in the arbor, and to extend entirely through it, in manner as specified.

222. CHRONOMETER ESCAPEMENT; Thomas Morrison, Assignor to A. S. Solomons, City of New York.

Claim—1st, Vibrating the detent of a chronometer (or single beat) escapement by direct mechanical action. 2d, The detent lever vibrating on pivots or a staff, when operating in the manner set forth. 3d, The arrangement and operation of the pallet, in the manner specified.

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223. TOOLS FOR MANUFACTURING WIRE RIDDLES; Sanford Adams, Boston, Massachusetts.

Claim—The tool for manufacturing riddles, having teeth, operating in the manner substantially as set forth.

224. WASHING MACHINES; Wm. T. Armstrong, Sandwich, Illinois.

Claim—Making one or more inverted ribbed curves in an arched or curved rubber, substantially as described.

225. SCRUBBING MACHINE; Samuel M. Barnett, New Orleans, Louisiana.

Claim—The tri-lateral frame provided with the soap and water boxes, arbor with brush attached, and the movable bars with brushes and sponges, either or both, or their equivalents, attached, the whole being arranged as set forth.

226. GRAIN-DISCHARGING ATTACHMENT TO HARVESTING MACHINES; J. F. Black, Lancaster, Illinois.

Claim—Operating the gavel discharger, that is to say, the rotating arms of shaft from the driving wheel through the medium of the wheel provided with the slot and tooth, and the pinion provided with a quadrilateral plate, as described.

227. CAR SEATS; A. C. Blondyn, St. Joseph, Missouri.

Claim—The combination and arrangement of the swinging frame, extending and rolling mattress, the roller, D, shaft, H, roller, H', and cord, G, or their equivalent, for operating said mattress, and the sectors to which the seat bottoms are secured, by which a seat facing either end of the car, or a reclining or sleeping couch, capable of accommodating the two occupants of the seat, can be obtained, the whole being constructed as described.

228. CHURNS; James H. Bump, Morris, New York.

Claim—The arrangement and combination with the churn of a chamber through which the air that mingles with the cream is made to circulate, substantially as described.

229. EXTENSION SPLINTS; William Bunce, Sullivan, Ohio.

Claim—The combination and arrangement of the side pieces, forming with the band and set-screws an

adjustable splint, the foot-piece with its joint, b, and set-screw, the flexing braces, the extension bar, the windlass and cord, the perineal pad and pads, all combined and arranged as described, so as to form an extension splint, operating in the manner substantially as set forth.

230. STEAM PUMPING ENGINE; Ezra Cope, Cincinnati, Ohio.

Claim—The arrangement of steam and water passages, both in one trunnion, and guide rods, to complete an independent pumping engine. Further, arranging the escape steam passage, to separate the steam supply and water passages, to prevent condensation of the supply steam, all substantially as set forth.

231. WASHING MACHINE; Theodore G. Eiswald, Providence, Rhode Island.

Claim—The washing of clothes by means of the arrangement, construction, and combination of the two cylinders revolving in different directions, substantially as described.

232. CIDER MILLS; John Eiberweiser, Cincinnati, Ohio.

Claim—The particular construction and arrangement of two cylinders, as described.

233. BRICK MACHINES; Thomas Forbes, Kansas City, Missouri.

Claim—The arrangement and combination of the variable rods with the sockets, pinions, and spur wheel, as described.

234. GRAIN SEPARATORS; Aaron Foster, Quincy, Illinois.

Claim—The arrangement of the annular receptacles, in combination with the trumpet-shaped cone, and also the employment of the interior of said cone as an additional receptacle together, for the purpose of assorting the mixed grains, after separation from the wheat, according to their respective qualities, substantially as described.

235. BEDSTEAD BOTTOM; Samuel E. Hartwell, City of New York.

Claim—The adjustable rack, carrying the elastic loop and connected to the slat by the clasp, substantially as specified.

236. SELF-MOUSING HOOK; John R. Henshaw, Middletown, Connecticut.

Claim—A self-mousing hook having a socket and ear, and a horizontal spring, made as described.

237. RAILROAD SWITCHES; Simeon Heywood, Claremont, New Hampshire.

Claim—The arrangement and construction of the bent or curved bars, having racks attached and operated by a pinion, as described.

[In connexion with the ordinary switch rails this inventor uses a movable frog, so arranged that the switch and frog will be operated simultaneously by the movement of a single lever or shaft, and the frog, as well as the switch, moved in line with the rails over which the train is to pass. By this improvement a continuous track is formed, thereby obviating the objections to the usual stationary frog, to wit: the danger of the cars being thrown from the track, and the wear and tear of the switches, as well as the wheels and running gear generally of the cars, in passing over the switches.]

238. PEN FOUNTAINS; Josee Johnson, City of New York.

Claim—The application to the ordinary pen of a spiral spring fountain, when constructed with an adjustable band, in the manner described.

239. MACHINES FOR MAKING CANDLES; John Jones, Baltimore, Maryland.

Claim—The feeding and packing roller with blades moving alternately in and out by the cam, as shown, or by an eccentric, or any other device, for the purpose of feeding and working tallow, wax, or other plastic material. Also, the combination of one or more feeding and packing rollers with the various moulds for the different purposes to which it is applicable. Also, the entire combination of the machinery for the purpose of cutting and removing the candles, as described.

240. CHEESE PRESS; Hartwell Kendall, East Dorset, Vermont.

Claim—Applying the power through the sliding frame, by means of the ratchet wheel, and the pawls, lever, and crank, connected therewith, or their equivalents, so that the shaft of said ratchet wheel shall act upon and move the eccentric, at the same time serving as an anti-friction roller, whereby simplicity, lightness, and compactness of construction, and greater efficiency of action are secured, as specified.

241. CHIMNEY CAPS; Bernhard Kihlholz, St. Louis, Missouri.

Claim—The chimney smoke regulator, consisting of the pipe, deflector, and cap, enclosed in cylinder, attached to cover, the whole constructed as set forth.

242. DINING AND OTHER TABLES; Alexander Kinkead, Washington Co., Ohio.

Claim—The combination and arrangement of the adjustable drawer-like or chambered rotating tablet, with the hinged upwardly folding disk, when constructed as shown, and used with a dining or other table, for the purposes substantially in the manner as set forth.

243. GASOMETERS; George W. Kraft, Philadelphia, Pennsylvania.

Claim—The construction and application of the V-shaped cup or lute, whether as shown by the inner section, fig. 2, or by the inner and outer section, fig. 3, and this I claim whether it be accomplished precisely as described, or in any manner equivalent thereto, producing substantially the same result.

244. FLAT IRON; David Lithgow, Philadelphia, Pennsylvania.

Claim—The combination of the two jet pipes and the heating plate, in the manner substantially as described.

245. SPOKE MACHINE; Luke L. Knight and D. H. Rice, Barre, Massachusetts.

Claim—The employment or use of two carriages, in combination with expanding cutter heads, or any proper cutting tool arranged to operate substantially as set forth. Also, the circular saw, in combination with the expanding cutter heads, when the parts are connected so as to operate conjointly, as shown, to wit: as regards their lateral and rotating movements, and used in connexion with the carriages, for the purpose specified. Further, the loaded arms, e, attached to the swivels, d, the arms being forked at their outer ends and used in connexion with the curved bars.

246. BRICK MACHINES; John Kutts, Philadelphia, Pennsylvania.

Claim—The main cylinder, when constructed and arranged in the manner and for the purpose specified, that is to say, with the stationary hollow axis with the beams or truss through the same, the eccentric collar, piston, with its knuckle joint and shoe and division plates. Also, the arrangement of the double chamber or box beam over the cylinder, in combination with the back horizontal pistons and cut-off slide, propelling bars,

and levers, all arranged for joint operation in the manner set forth. Also, the compound or double levers in the box over the press beam, when these are constructed and arranged in connexion with the gearing or fly-wheel, substantially in the manner set forth. Also, the double rimmed elevating and filling boxes, when constructed as specified. Also, the pulverizers, when constructed in the manner specified. Also, the fly or wing wheel for lowering the brick from one belt to another belt, at right angles thereto, when constructed as described.

247. BRIDLES TO PREVENT HORSES FROM KICKING OR RUNNING AWAY; John M. Lanier, Eufaula, Alabama.

Claim—The employment of two bits, so arranged with two sets of reins that one bit will operate upon the lower jaw, while the other operates upon the roof of the mouth and upper jaw, the same being combined and operated in the manner specified.

248. LAMP WICKS; James Y. Leslie, Brooklyn, New York.

Claim—A lamp wick composed of a single yarn when double looped, as described.

249. PADDLE WHEEL; Richard B. Locke, Stapleton, New York.

Claim—Connecting the plates to each other or to staying rings at their adjacent angles, substantially as described.

250. HYDRO-CARBON VAPOR BURNERS; Alonzo M. Mace, Springfield, Massachusetts.

Claim—The use of a heating chamber, connected with vaporizing tubes at the crown or upper part and over the flame, constructed substantially in the manner set forth.

251. COTTON PRESSES; Cornelius Martratt, Waterford, New York.

Claim—The application of the racks connected to the frame, in combination with the pinions and side shafts revolving freely, and connected to the sides of said follower, for the purpose of distributing the pressure equally over the surface of follower as it is raised, and obviating the tipping and end strain, and diminishing the friction, substantially as set forth.

252. TRANSIT INSTRUMENT; Robert C. Matthewson, San Francisco, California.

Claim—The manner in which the instrument is constructed, so as to ascertain the longitude, and run a true parallel of latitude by fore and back sights.

253. ORNAMENTAL GLASS; Jasper S. Miles, Ann Arbor, Michigan.

Claim—The said manufacture produced by the combination of two plates of glass with coloring matters, by a process like that specified.

[The colors, which may be zinc white, vermillion, Paris green, ultramarine blue, or others, are ground very fine, and mixed with boiled linseed oil and Damar varnish. These are then laid on two pieces of glass with a dubber or brush, and one piece of glass placed on the other, with their painted surfaces in contact. They are then worked upon one another slightly with the hand, separated, and left to dry—they are again placed in contact, and secured together, and when seen with the light shining on them, have a highly ornamental appearance. When viewed placed between the observer and the light, the coralline or foliated appearance is distinctly visible.]

254. REFRIGERATOR; James Naughten, Cincinnati, Ohio.

Claim—The combination of the valves and rods, arranged substantially as set forth.

255. DEVICE FOR ELEVATING WATER BY THE COMBUSTION OF A VOLATILIZABLE HYDRO-CARBON; Robert Nelson, City of New York.

Claim—Elevating water by producing a vacuum with a proper receiver, by means of any hydro-carbon fluid, when so applied and arranged with suitable mechanism that the fluid will be volatilized in proper or desired quantities, and exploded by one and the same source of heat. Further, the particular means employed for volatilizing and exploding the hydro-carbon fluid, to wit: the box, M, provided with a lamp and valve, and attached to the box, G, into which the tube, J, being provided with a cock, which, as well as the valve, is operated by the movement of a slide, substantially as described.

256. RAILS FOR STREET RAILROADS; Samuel Nicolson, Boston, Massachusetts.

I do not claim making the railroad car wheel bearing surface of the rail with a flat or slightly curved top, having its corners rounded down to quadrantal arcs, such being the common way of forming the said rail. But I

Claim—Making the rail with the straight or slightly curved inclined surface or plane, a c, arranged with respect to the surface of the street, as shown. Also, as an improvement in the guard, making it a flat plane, arranged as shown. Also, making the inside corner of the rail angular, with reference to the upper surface of the horse tread, as shown.

257. COOKING STOVES; John Pearson, Jr., Newburyport, Massachusetts.

Claim—The combination and arrangement of the hollow back of the fire-place with the oven, the fire-place, and the flue, whereby the heat of the fire-place and the said flue is made to warm the air which passes into the hollow back, such air being subsequently discharged into the oven, as described. Also, the combination and arrangement of the smoke flues and the air flues, the whole being disposed with respect to the oven, essentially as described. Also, the air guard as arranged on the upper smoke flue, and with respect to the air register and discharge pipe thereof, substantially in manner as specified.

258. RAILROAD CAR COUPLING; Philander Perry, Troy, New York.

Claim—The combination of the horizontally and vertically moving links, with the parts which adjust said links perpendicularly, so as to suit different heights of platforms, and with the vertical lever and horizontal rod for moving the links apart horizontally, so as to disconnect the cars, and with the sliding spring boxes which allow the cars to approximate without straining the pins when the cars crowd upon one another, substantially as set forth.

259. COPYING PRESS; Edwin and Jacob B. Platt, Clarke Co., Georgia.

Claim—The stirrup and its plates, arranged substantially as set forth. Also, the frame, in combination with its levers, so arranged with the bed plate and follower as that they can be easily separated from each other, and then packed to form a portable copying press.

260. WASHING MACHINE; Joseph F. Pond, Cleveland Ohio.

Claim—The suspension of the rollers upon the vibrating bars at the extremities of slide rods, in combination with the spring and upper roller, the whole constructed as set forth.

261. Mode of Operating Pumps; Daniel J. Rogers, Magnolia, North Carolina.

Claim—The arrangement of the intermediate auxiliary lever, flexible frame, pistons, elevated rocking shaft, elevated weighted rod, and pendulous handle or lever, in the relation to each other shown.

262. Method of Insulating and Supporting Lightning Rods; Elkanah C. Rogers, Boston, Massachusetts.

Claim—Making the insulator cap with the adjustable or turning loop, a, applied to it, and arranged so as to operate substantially as described. Also, combining with the rod or conductor and adjustable rest, applied to it and the insulator cap, substantially in the manner specified. Also, combining with or arranging in the cap of the insulator, and with respect to the insulating material, an annulus or ring, applied substantially in the manner set forth.

263. Tiller Rope Protector; John Sample, Meadville, Mississippi.

Claim—Placing a double casing of metal, made in sections, so as to reach their interior, and with air space between them, around, over, or under the tiller ropes of vessels, to protect them from the accidents of fire.

264. Connexion of Steam Engines with Propellers of Steam Vessels; Ross and Thomas Winans, Baltimore, Maryland.

Claim—The combination of two engines or sets of engines with an intermediate vertical transverse propelling wheel, to the shaft of which the engines are directly connected, substantially as set forth.

265. Steam Engines; C. A. Schultz, City of New York.

Claim—The revolving cam wheel, with the opening cams and adjustable cut-off cams, constructed as described. Also, the socket, with guide rods.

266. Machine for Mining Coal; Elisha Simkins, Allegheny, Pennsylvania.

Claim—1st, The arrangement of the double or compound slide and sliding frame, when used in connexion with the stationary frame, and operated by the screws and the nut, as described. 2d, The arrangement of the cam, slide rack, wheel, shaft, shifting piece, levers, ratchet wheels, and the ratchet pawls, for the purpose of moving the upper end of shaft back and forward, and for operating the screws, as described. 3d, The arrangement of lever and the connecting rod, for the purpose of regulating the angle of the picks, as described. 4th, The arrangement of the flexible connecting rod, the crank, the shaft, the arms, the pick receivers, and the picks, as described.

267. Washing Machine; H. E. Smith, Philadelphia, Pennsylvania.

Claim—The vessel, with its yielding valved diaphragm and the perforated diaphragm, or its equivalent, in combination with a pipe communicating with the vessel at a point above, and the pipe at a point below, the said diaphragms, and both pipes communicating with any suitable heating apparatus, substantially as set forth.

268. Machine for Drawing Bolts; C. L. Stevenson, Charlestown, Massachusetts.

Claim—A machine for drawing bolts from timber, consisting essentially of the rotating toothed wheel, which is forced up to the bolt by pressure applied through the roll, or its equivalent.

269. Applying Power to Cranks of Engines; Thomas Stewart, Philadelphia, Pennsylvania.

Claim—Keeping the piston rod at rest, whilst the crank makes about one-fourth of its revolution on each opposite side of an imaginary line passing across the centre of said crank's shaft, at right angles with another, such line passing through the axis of the piston rod, the same being effected by means of the yoke, or its equivalent, constructed so as to operate upon the crank, substantially in the manner described.

270. Bee Hives; Peter Taltavull, Washington City, D. C.

Claim—The arrangement of a simple rectangular containing box, suspended diagonally, in combination with honey boxes therein arranged similarly, all having outlets or passages downwards from their extreme lower edges, whereby the entire hive is rendered self-clearing, and a sloping roof by the same arrangement is produced, substantially as specified.

271. Machinery for Pearling, Polishing, and Finishing Rice; R. P. Walker, City of New York.

Claim—The revolving cylinder, coated with emery and carrying the sectional rubbers of gum elastic, or equivalent material, in combination with the hollow cylinder revolving in the opposite direction to the cylinder, for the purpose of pearling and polishing rice or grains in substantially the manner specified. Also, the cylinder, constructed with alternate screens and emery surfaces, to act in connexion with the interior revolving cylinder, d, to remove and pass away the douse and chits.

272. Apparatus for Generating Gas; A. B. Wilson, Waterbury, Connecticut.

Claim—1st, The combination of a still with passages leading therefrom downward to a pipe, and so combined therewith as to protect the still from heat, the two being constructed as specified. 2d, In combination, a gas still, converting passages, and a valve, all combined substantially in the manner set forth.

273. Apparatus for Cooling Warts; John Wilkins, Troy, New York.

Claim—1st, The cooling apparatus, as described, with the thin metallic operating plate placed horizontally and fastened so as to be easily removed for the purpose of cleaning, together with the specific arrangement of ribs and joists, or their equivalents. 2d, The distributing and collecting troughs with their respective ice water and waste water troughs, at the ends of the operating plate. 3d, The combination of the said parts, namely, the operating plate with its joists, ribs, and modes of fastening troughs at each end, and regulating valve, or of parts substantially the same, when they are employed as a cooling apparatus, in the manner set forth.

274. Window Stop; Turner Williams, Providence, Rhode Island.

Claim—The roller, shank, spring, lever, or their equivalents, in combination with the inclined surfaces, and operating in the manner substantially as set forth.

275. Hulls of Steam Vessels; Ross and Thomas Winans, Baltimore, Maryland.

Claim—Constructing the hull in the form of a spindle, substantially as described.

276. Steam Vessels; Ross and Thomas Winans, Baltimore, Maryland.

Claim—1st, The combination of a spindle-shaped hull, formed of two separate water-tight vessels, united by a sleeve or framing, with a propeller, arranged and operating substantially as set forth. 2d, The sleeve, in combination with the ribs or standards, for connecting the two end portions of the spindle-shaped hull, steadying the vessel as a keel does, and directing the course of the water as it enters and leaves the space occupied by the propeller. 3d, The combination of the two end portions of the spindle-shaped hull, with the towers and the bridge between them, for the purpose of affording ingress to, and egress from, each end of the hull,

and a means of communication between them, and also supplying a suitable means of ventilation of the two parts of the hull, substantially as set forth.

277. CONSTRUCTION OF OCEAN STEAMERS; Ross and Thomas Winans, Baltimore, Maryland.

We are aware that it has been proposed to use an annular propeller revolving around a vessel, but such a form, from the great amount of friction produced, and its liability to distortion, owing to its want of strength, could not be employed with success; besides, our invention is easily distinguished from such a contrivance, as this refers only to a propelling wheel, which has a continuous radial support from the axis of rotation. All such arrangements are therefore essentially different from ours, and we

Claim—The combination of a vertical transverse trunk within the hull of a vessel, with a screw propeller of large diameter whose blades shall project beyond the outline of the hull, substantially as set forth.

278. PREPARATION OF ALUMINUM; Luige Ferrari Corbelli, Florence, Tuscany, and Vincent Paitti, of the Duchy of Modena, Assignors to L. Ferrari Corbelli, aforesaid.

Claim—1st, The combination of operations set forth, whereby we are enabled to reduce aluminum from earthy matters containing it as a base, or in combination with other matters. 2d, The application of the prussiate of potash to the clay or earthy matters, and the treatment of such clay or earthy matters with prussiate of potash in the presence of heat, substantially as described.

279. ARITHMETICAL PROOF RULE; S. S. Young, Eaton, Ohio,

Claim—The described instrument for proving the result of arithmetical calculations, when constructed and operated substantially in the manner set forth.

280. MANUFACTURE OF ALUMINUM AND CALOMEL; Luige Ferrari Corbelli, Florence, Tuscany, and Vincent Paitti, of the Duchy of Modena, Assignors to Luige Ferrari Corbelli, aforesaid.

Claim—The process described of manufacturing at the same time aluminum and protochloride of mercury, by means of galvanic precipitation, as set forth.

281. PATCHING BALLS FOR BREECH-LOADING RIFLES; L. H. Gibbs, Assignor to the Gibbs' Arms Company, City of New York.

Claim—The method of patching a rifle ball, substantially as set forth.

282. HINGES; R. Hart, Washington Co., Assignor to T. F. Hall, Marietta, Ohio.

Claim—The employment of the shifting yoke, and in combination therewith of the spring, constructed substantially in the manner set forth. 2d, The combination of the hook or part having a salient angle, constructed substantially as above set forth, with the inclined plane for closing and opening gates and doors.

283. BUREAU BEDSTEAD; Francis Hoffman, Assignor to self and John Muzell, City of New York.

Claim—A bureau bedstead, in which the bed bottom is hinged so as to fold and expand horizontally when opened or closed, as described.

284. COMPOSITIONS FOR ROOFING; Josee Johnson, Assignor to J. Ditto & Co., City of New York.

Claim—The use of mica for roofing, covering the sides of buildings and boat decks, as set forth.

285. WATER MOTORS; Caleb Rider, Plymouth, Assignor to G. T. McLauthlan, Boston, Massachusetts.

Claim—The union or combination of the following elements or features, viz:—1st, Making the inlet aperture of the tub, and the outlet apertures of the wheel of the same aggregate area. 2d, Forming the buckets of two planes or curves, the lower one making an angle of 26°, or thereabouts, with the plane of rotation of the wheel, and 90° with the float or upper portion of the bucket. 3d, Making the tub circular and of sufficient height and diameter to allow free action of the water therein, and causing the water to enter from the flume on a tangent thereto, whereby the inlet current is relieved from immediate and direct contact against the floats and buckets of the wheel, and caused to spend its force upon the waters already accumulated in the tub, and through that upon all the floats and buckets of the wheel itself, the whole forming a water motor, arranged substantially as described.

286. SEWING MACHINES; A. W. Sangster, Assignor to V. M. Rice, Joel Thayer, James Sangster, and Eliza Remington, Buffalo, New York.

Claim—The combination of the cam or wheel provided with one or more projections on its periphery, with the adjustable foot-piece, or its equivalent, for feeding the cloth and regulating the length of stitch in the manner described, and without the use of an intermediate feed-piece.

287. FORMING BATS FOR FELT CLOTH; M. D. Whipple, Charlestown, Assignor to A. B. Ely, Boston, Mass.

Claim—1st, Shortening the staple, in the manner and for the purpose substantially as set forth, previous to forming the bat. 2d, The combination of the draw rolls with a brush cylinder, a doffer, and a suitable device upon which to form the bat, operating in the manner substantially as described.

288. MACHINERY FOR FULLING CLOTH IN THE PIECE; M. D. Whipple, Charlestown, Assignor to A. B. Ely, Boston, Massachusetts.

Claim—Fulling or felting cloth in the piece by the action of rollers revolved alternately in one direction and the other, when the cloth is wound loosely on a spool, in the manner substantially as set forth.

289. MACHINERY FOR COMBING COTTON; M. D. Whipple, Charlestown, Assignor to A. B. Ely, Newton, Mass.

Claim—1st, The vibratory elastic feed rolls and permanent knife edge for holding the staple, as set forth. 2d, The combination of a feed for introducing the material into the machine, the vibrating card, and nippers, and the stationary cards, operating in the manner substantially as described.

EXTENSIONS.

1. METHOD OF RENDERING LARD; Ebenezer Wilson, Cincinnati, Ohio; patented October 9, 1844; re-issued May 7, 1850; extended October 7, 1858.

Claim—In the described apparatus for extracting or rendering lard, &c., by the action of high pressure steam, combining with a steam-tight tank, and provided with one or more discharge holes, for the discharge of the residuum, and with a perforated steam pipe at the bottom for the introduction of high pressure steam, a perforated false bottom above the steam pipe to sustain the charge under the weight and pressure, to admit of and insure free passage of the steam through the charge, and also the free descent of the water of condensation. Also, in combination with the tank, substantially such as herein described, the employment of one or more try cocks near the top thereof, and a regular discharge cock at or near the bottom, for the purpose of ascertaining when too much water of condensation has accumulated, and to discharge the same, to retain a

sufficient space above for steam to insure the passage of steam through the charge. Finally, in combination with a tank, the employment of a series of discharge cocks arranged at different levels for the purpose of drawing off the rendered lard, &c., as it floats on the water of condensation, and thus insure the separation of the pure lard, &c., from all foreign substances, when this is combined with the relief or discharge cock, as described.

2. STEAM BOILERS; Frederick E. Sickles, City of New York; patented October 19, 1844; extended October 8, 1858.

Claim—1st, My improvement in the periods of the movements of the valves, by which they are opened and closed relatively to each other and to the movement of the piston, by means of which the piston completes each stroke in equilibrio, or nearly so, without admitting steam against the movement of the piston, by a lead to the steam valve, which is effected as before stated by opening the lower exhaust valve, before the end of the upward stroke of the piston, and before the upper exhaust valve is closed, and opening the upper exhaust valve before the end of the downward stroke of the piston, and before the lower exhaust valve is closed—the movement of the steam valves being so regulated as to admit steam to the cylinder only after the exhaust valve on the corresponding end of the cylinder has been closed. Also, as my next improvement, as a means of carrying into effect my first and essential improvement, the arrangement of the toes on the rock shaft in such manner relatively to the location and forming of the feet on the lifting rods, that at the middle, or nearly so, of the rocking motion of the rock shaft, both lifting rods, with their exhaust valves, shall be partly up, as described. Also, in combination with this arrangement, the slip of the lifters on the steam valve stems, to ensure the closing of the exhaust valves before the opening of the steam valves on the corresponding ends of the cylinder, as described.

ADDITIONAL IMPROVEMENT.

1. METALLIC HOOPS FOR FASTENING COTTON BALES; James R. Speer, Pittsburgh, Pennsylvania; patented Dec. 1, 1857; additional dated October 26, 1858.

Claim—As an improvement on my improved clasp of March 23, 1858, the use of a clasp for metallic bands, constructed as described, having a single aperture only for the insertion of the hooked ends of the band, the plate of iron of which it is formed being bent across the aperture, so as to present a sufficient opening for the ready insertion of the hooked ends of the bands, in the manner described.

RE-ISSUES.

1. MANUFACTURE OF PAPER FROM WOOD; Wm. F. Ladd, City of New York, and Morris L. Keen, Philadelphia, Pennsylvania, Assignees (through mesne-assignment) of Charles Watt and Hugh Burgess, London, England; patented July 18, 1854; ante-dated August 19, 1853; re-issued October 5, 1858.

Claim—The pulping or disintegrating of shavings of wood and other similar vegetable matter for making paper, in the manner substantially as described, according to the nature of the vegetable substance to be treated.

2. WEAR IRON FOR CARRIAGES; I. George Lefler, Philadelphia, Pennsylvania; patented Sept. 8, 1857; re-issued October 5, 1858.

Disclaiming the formation of "goose-necks," or recesses in the bodies of vehicles, and disclaiming the use of metallic guards or "wear irons."

Claim—Without limiting myself to any precise form or exact proportion, the construction of carriage or other bodies with a metallic recessed guard, constructed and arranged in the body of the vehicle, substantially as described, for the purpose set forth.

3. CLEANSING SUGAR; Francis P. Hurd, Assignee (through mesne-assignment) of Joseph Hurd, Stoneham, Mass.; patented Oct. 3, 1844; extended Oct. 2, 1858; re-issued October 5, 1858.

Claim—1st, The process of separating sugar from any liquid matters with which it may be mixed, by filling the mixed mass into a vessel constructed and then acting upon the same by centrifugal force, substantially in the manner specified. 2d, The washing of impurities out of the sugar, by admitting a liquid into a vessel in which sugar is being exposed to the action of centrifugal force, as specified. 3d, The process described of obtaining a mass of sugar free from liquid impurities by filling the mixed mass into the top of a vessel, constructed substantially as described, and having a closed bottom, and there exposing the mass to the action of centrifugal force, and then withdrawing the sugar out of the upper end of said vessel when separated. 4th, The process of obtaining a mass of washed sugar by charging sugar into the top of a vessel, constructed as specified, with a closed bottom, and then exposing such sugar to the action of centrifugal force, and while so exposed, admitting currents of liquid to wash the sugar. Finally, withdrawing the washed sugar out of the top or upper end of the vessel, as specified.

4. DRY GAS METERS; Alexander A. Croll, London, England; patented February 22, 1853; re-issued October 5, 1858.

Claim—Fastening the diaphragms to the partition plate, and on either side thereof, in contradistinction to attaching them by separate flanch rings to the sides of the metre, and at or near the front and back thereof. Also, the arrangement of pendant rods or levers, with suitable guides near the outer edges of the disks on opposite sides of their axis, to steady and direct the motion of the movable partitions, as described. Further, continuing the inlet and outlet pipes down the sides of the rectangular case, below the points required for the passage of the gas to and from the metre, to form separate condensation chambers. Likewise, enclosing by a separate interior cover or case, the valves of the metre, for protection of the operating and registering gear from gas, and to facilitate adjustment, substantially as set forth.

5. CHAIRS; James Fernald, Boston, Massachusetts; patented July 22, 1856; re-issued Oct. 12, 1858.

Claim—The new manufacture of chair backs, composed of a convex-faced solid block of wood, and a single metallic support rod, they being constructed and applied together and to the chair seat, essentially as specified. Also, making the back rest oblong or oval, when made to rotate in the manner specified.

6. BOLTING FLOUR; Edward Broadfield, Rochester, New York; patented September, 1846; re-issued October 12, 1858.

Claim—1st, The cast heads or annular rings with the flanch and hubs, or any mechanical equivalent therefor, when used in connexion with wire cylinder or circular wire bolt. 2d, In combination with the chain, the cylindrical journals, or their equivalents, by means of which the bolt revolves in or on a support inside the space for admitting the feed instead of on the outside, as in the English bolt. 3d, The combination of the

cards or metal points and brushes, attached to bars of the inside cylinder, for the purpose specified. 4th, The spout, when arranged in relation to the cylinder or bolt, and used in connexion with said cylinder or bolt, and the inside brush cylinder, as specified.

7. SEWING MACHINES; The Grover and Baker Sewing Machine Co., Boston, Assignors of Shelburne C. Bloodgett, Georgetown, Massachusetts; patented December 20, 1853; re-issued October 12, 1858.

Claim—The formation of sewing in cloth or other material, by the interlooping of two threads by the conjoint action of two needles, in such manner that each needle shall be made to carry a loop of thread through a loop formed by the other needle and through the cloth, whereby one thread serves as a binding thread to the other, substantially in the manner described. Also, moving the cloth to be sewed by a needle, or its equivalent, operating substantially as herein set forth, to pierce the cloth and move it the necessary distance required to form successive stitches.

8. VENTILATING ATTACHMENT TO BE APPLIED TO PUMPS; G. C. King, Assignee of C. N. Lewis, Seneca Falls, New York; patented November 17, 1857; re-issued October 26, 1858.

Claim—The arrangement and combination of the perforated base, cap, and perforated tube, or other equivalents, with the pump barrel, as set forth, whereby the ventilator becomes attached to, and forms a part of, the pump.

9. ELLIPTIC CUSHION FOR RAILROAD CARS; R. Jones, York, Pennsylvania; patented April 27, 1858; re-issued October 26, 1858.

Claim—1st, The local relation and mode of application of the semi-elliptic buffer to any and all cars wherever applied, in such manner as is represented by the letters, and for the purposes set forth. 2d, The combination and arrangement of the elliptic cushion for easing off collisions, as described, and arranged in every part thereof, in the frame work, as represented by the letters, and operating substantially in such manner, and wherever applied to cars, as described, and for the purpose set forth.

DESIGNS.

1. CAST IRON FENCES; Martin Briggs, Rochester, New York; dated October 5, 1858.
2. TRADE MARKS; Richard P. and Charles Bruff, and George A. Scaver, City of New York; dated October 5, 1858.
3. COOKS' STOVES; N. S. Vedder, Troy, Assignor to G. W. Eddy, Waterford, New York; dated Oct. 5, 1858.
4. CAST IRON FIRE SHOVELS; Wm. Bennett, City of New York; dated October 12, 1858.
5. LOCKETS; R. C. Randall, Providence, Rhode Island; dated October 19, 1858.
6. CAST METAL TABLETS; Ezra Clark, Portland, Assignor to Seth Clark, Westbrook, Maine; dated Oct. 26, 1858.

MECHANICS, PHYSICS, AND CHEMISTRY.

*Ice Phenomena, from Observations on Rice Lake.** By J. H. DUMBLE, C. E.

The phenomena attending ice are, I believe, but little understood or investigated in Canada. That water increases in bulk during the process of crystallization is well known. The mere facts, that ice floats on water, and that vessels of any description which contain water fracture while it is congealing, are proofs sufficiently practical. But that ice itself should be capable of expanding and increasing in bulk is not equally well known, although many practical proofs are afforded.

This property of expansion and contraction of ice aids in fracturing and reducing the floating and gigantic iceberg; and Dr. Kane tells us, that but for changes of ice at temperatures *far below the freezing point*, causing pressure, collapse, fracture and disruption, the short Arctic summer would fail to open the Arctic Seas. I may add, that the ignorance, or want of a proper appreciation, of the properties of ice, evinced in the construction of numerous wharves, piers, and bridges on the inland lakes and rivers of Canada and the Northern States, has proved a source of infinite annoyance and of immense expense.

The Cobourg and Peterborough Railway bridge across Rice Lake supplies a remarkable instance, from observations of the effects of ice

* From the Canadian Jour. of Industry, Science, and Art, Sept., 1858.

on which some valuable practical conclusions may be deduced. Timber being plentiful along the shores of this lake, a cheap and substantial form of pile and truss bridge was constructed.

This bridge on more southern waters would doubtless have been considered a most suitable structure, but owing to the violent and almost irresistible force of ice, while expanding, a considerable portion of this structure now presents the appearance of a complete wreck. Having, as Engineer of the Cobourg and Peterborough Railway, had two winters' experience of ice phenomena on Rice Lake, and having carefully noticed the peculiar circumstances attending the various movements of the ice, I submit my observations and remarks, hoping that from them a somewhat satisfactory and perhaps correct theory may be deduced.

In the first place, it is well to know, that the violent movement of the ice on Rice Lake is that of contraction and expansion, caused entirely by *change of temperature*. The lake generally "takes" with ice during the month of December at a pretty high water level, which level the dam across the outlet preserves until spring. Currents, therefore, cannot be said (as in the case of rivers) to influence the movements of the ice. Neither have we on Rice Lake those other various causes, such as differing temperatures of ice and sea water, currents, or wave action, which produce the disruptions of Arctic ice. It is observed on Rice Lake that the action of the mid-day sun will set the *glare ice* immediately in motion. Warm winds, snow storms, and rains, do likewise produce the same effect, when the ice is glare and free from water or snow. This motion is generally quite perceptible; it is not shrinkage or contraction, but on the contrary is a visible stretching and expanding of the field-ice, generally towards the shores of the lake and of islands. The movement of the ice is at times very gradual, and is accompanied by a slight crackling noise. Again the expansion is rapid and violent, the movement being by a succession of vigorous jerks, accompanied by a hollow rumbling sound, seemingly from under the field-ice, while at intervals there occur sharp loud reports like that of cannon.

That ice does *expand* under such circumstances is very evident, as it may be seen creeping many feet on to the shores, without the appearance in the lake of any compensating fissures whatever. Ice may therefore be said to expand by a *high temperature*, that is, by a temperature higher than that which had just previously existed. The phenomena of ice contracting and expanding at the same temperature on different occasions is sometimes witnessed. For instance, should the thermometer indicate a temperature of minus 30°, and then suddenly rise to zero, expansion would immediately be the result; again, should the temperature indicate plus 30°, and suddenly fall to zero, contraction of the ice would speedily follow. The force and violence with which ice expands or shoves depends entirely on the *extent* of the *change* of temperature. The most violent shoves of ice occur previous to rain storms. A rise in temperature of 20° or upwards produces violent expansion. Various instances may be cited of the effects

produced by ice when expanding; evidence of its power is very indelibly written on parts of the Railway Bridge before-mentioned. Portions of this structure on piles have been, for long distances, bent and inclined even to an angle of 45° in a most uniform and extraordinary manner. Strong oak piles that would not bend have been cracked and splintered, hundreds of heavy cap timbers of sound pine have been snapped across like reeds, and heavy iron rails have been curved and doubled up, by the almost irresistible pressure of the ice.

Instances of trees growing on the shores having been torn up by the roots are of frequent occurrence. Large boulders weighing two tons or more, have been lifted several feet from the shore, and then pressed into the timbers forming the abutments of the bridge.

Channels cut for the purpose of moving timber frequently close by the expansion of the field ice, and the timbers are heaved out high and dry.

The greatest amount of expansion that I have witnessed at any one time in a horizontal direction was six feet. This may be considered a maximum shove.

When ice shoves on to the shores of lakes or islands it presents different forms of fracture, according to the nature of the resistance it meets with. Should the shore be low the ice merely runs up and fractures at the ripple mark. On the contrary, should the ice meet with resistance from a vertical shore or pier, a bursting up and piling of the fractured pieces would be the result.

Ice when contracting presents precisely the reverse of this fractured appearance. From my experience of ice I believe it is susceptible of contraction, but to a very limited extent. I have witnessed many sudden changes of temperature on Rice Lake, in some instances from plus 30° to minus 20°, indicating a fall of some 50°; and yet the contraction of the ice, as made visible by open fissures, has not exceeded three inches.

I have repeatedly heard of openings, that have occurred during former years, of several feet in width. I am inclined, however, to believe, that the distinction between a shove and an open crack, or fissure, was not sufficiently understood by my informants.

I have witnessed in several shoves that when the ice contracted, the fractured and elevated pieces, which previously came in contact with each other, would fall, and perhaps partly under the field-ice. A space in the centre thus presented open water. This open water has probably been mistaken for a fissure caused by contraction.

I have heard of open fissures that have been seen eighteen inches in width, and this I think under peculiar circumstances, quite probable. That these fissures do sometimes occur, and that they never do occur unless the thermometer indicates a decided fall of temperature, is sufficient proof that ice contracts by a change to a temperature lower than that which had just previously existed. I may add, that contraction occurs generally at night, and is accompanied by sharp reports. A uniform temperature of the atmosphere does not cause either expansion or contraction of ice; it matters not whether the

temperature be high or low, no movement of any kind takes place. A coating of snow of any depth over six inches effectually prevents any motion in ice, by protecting it from the influences of the atmosphere.

I find from repeated experiment that the upper stratum of ice partakes of the temperature of the atmosphere (up to 32°). The lower stratum maintains a constant temperature of some eight degrees below that of the underlying water. A fall of temperature, therefore, affects only the upper stratum, while the lower stratum remains unaffected. A separating and fracturing of the mass at its weakest point must of course be the result. Just the contrary effect is produced when the upper stratum is affected by a high temperature; shoving and overlapping is the consequence.

Ice, unlike most other solids, does not seem to possess the property of contraction to the same extent as it does the power of expansion. This will seem apparent from the following evidence:—When ice expands, and is forced perhaps six feet on to the shore, it is observed that should the temperature again fall, this ice, which had previously exceeded its limits, does not recede to its former position, neither will the main field separate over a few inches from the fractured portions on the shore. On the contrary, should the temperature again suddenly rise, a still further advance of perhaps the same distance is made on to the shore.

This repeated expansion may occur many times during a winter, and yet little evidence of any contraction will appear. I have known channels some six feet in width, opened for the purpose of isolating the Rice Lake bridge, to be closed eight times within a month by the expansion of the field-ice.

An extraordinary instance of ice piling was witnessed on our new embankment. The ice shoved from both sides until the fractured pieces met in the centre of the track. The embankment is twenty-six feet in width at water level, and the rail is some six feet elevated.

The next phenomenon of ice, and that which seemed the most perplexing and difficult to account for, is the fact of ice shoving from different directions at different periods. In the first place it was noticed that it rarely or never shoved or fractured towards the centre of the lake; but on the contrary, the ice on the shores of the lake and of islands exhibited unmistakable signs of commotion.

It is but reasonable to suppose that any solid, equally dense throughout its dimensions, and susceptible of expansion, would, when equally acted upon by the active agent or moving cause, expand from its centre towards its circumference. We find such is the effect produced on any large field of ice of equal thickness and density, when acted upon uniformly by either the mid-day sun or warm winds. It is a fact, however, that it moves from other directions than from the centre of the lake. Shoves are sometimes witnessed from the east and sometimes from the west, to the north and to the south.

This phenomenon seemed as if it would baffle investigation, and it was only by careful observation of all the circumstances attending the

formation and movements of the ice that I could deduce a theory to my satisfaction. It would perhaps be well to describe that portion of Rice Lake which came within my observation. The railway bridge crosses the lake at its widest part. An island, containing some three acres of land, is situated on the line of the bridge, about three-fourths of a mile from the south shore. The bridge is formed of pile bents, with the exception of that portion immediately to the north of Tic Island, which is a continuous truss for half a mile. To the east is a wide and unobstructed expanse of water; at the distance of perhaps four miles from the bridge, the lake is narrowed by two promontories to a mile in width. Less than a mile to the westward a succession of beautiful islands rise from the lake. The Otonabee River, a large sluggish stream, enters the lake opposite those islands from the north. We have then at this particular part of the lake some twelve square miles of water-way. When this large space is therefore covered with glare ice, and is swept by warm winds after a previous low temperature, the amount and force of its expansion is somewhat surprising.

An instance of expansion from the centre of this large field may be cited:—In December, 1857, the lake was covered with dense glare ice five inches in thickness. The temperature was extremely low (ranging from minus 10° to minus 30°) for some time after the ice formed, it suddenly rose to plus 30° previous to rain. The expansion that followed was of the most violent description. The truss bridge superstructure moved two feet six inches on to Tic Island; the pile bridge south of the island was forced four feet and a half on to the south shore. The bridge was slightly shoved to the north, but was mainly preserved by the parallel channels that happened to be open for the purpose of isolating it in that direction. The centre of the bridge was not affected in the slightest, it being the neutral point. The ice was piled on to Tic Island from the north, east, and west, but on the south side it was torn away from the shore, exhibiting a fissure or opening some twenty inches in width.

Instances of the ice shoving on to the north and south shores of the lake, and also on to the shores of islands at the same time, are frequent. In fact, when the ice is equally dense and glare, and being fairly acted upon by a warm atmosphere, it must naturally expand from its centre to its circumference. But ice, owing to the peculiar circumstances under which it sometimes forms, is not found to be equally pure or dense, neither is it of uniform thickness. This ice is irregularly acted upon by warm winds, or by the slanting rays of the sun at different altitudes, shoves or expands from various directions other than from the centre of the lake. During the early part of the last winter the ice shoves were entirely from the east, in the vicinity of the bridge. Upon an examination of the ice, I found that to the eastward glare and dense, the ice to the west of the bridge was not so pure, but was seemingly thicker and more porous. This difference in its character was owing to snow having fallen during its formation; the bridge had retained the snow to the westward, and it became incorporated with the new ice.

The large open expanse to the east was constantly swept by the wind. The glare ice became the most dense during cold weather, and of course the most susceptible of expansion by heat. Consequently the shoving was (until subsequent rains had changed the relative character of the ice) from the stronger and most susceptible ice towards the weaker and less expansive.

Ice on any large and irregular sheet of water studded with islands, like Rice Lake, must naturally be of unequal thickness and density. I have therefore no doubt whatever, that the phenomenon of ice expanding and shoving from various directions is caused by the *unequal thickness, density*, and *glareness of the ice*, and likewise by the *manner* in which the *heated atmosphere strikes it.*

The fact that channels opened in the lake (no matter whether transversely or longitudinally,) always close up on the ice exhibiting the slightest tendency to expansion, is another proof that ice invariably expands and shoves to the line of such least resistance, and under peculiar circumstances from a general centre of the field.

On mentioning these circumstances to a friend from Kingston, he asked: "If ice moves from the centre of the mass, why is it, that it does not do so between Kingston and Wolf Island?" and stated, that on the contrary, a longitudinal shove and fracture are generally witnessed in the middle of the stream. I replied that the centre of the stream was generally the last to take, and being consequently the weaker ice, was sure to be crushed and fractured by the stronger ice on each side while expanding. I heard a seaman state, that he discovered the channel of a harbor (formed by the entrance of a river into the Black Sea,) by the appearance of an irregular line of fracture in the ice.

Another instance of ice expanding towards the line of least resistance may be cited:—When Presque Isle Harbor is entirely frozen over, any expansion of the ice is apparent by its encroachment on the shore. But when the bay is but partially frozen over the expansion is towards the open water, and is not visible on the shores.

In conclusion, I would mention another circumstance that occurs during the expansion of ice. It is observed, that when a large extent of field-ice expands towards the shore it does not shove into deep bays, but fractures from point to point, in a zigzag manner across the chord at the mouth. The thrust of the main field must find less resistance across this chord than around the area of the bay.

Ice is a most delicate thermometer, and from the brief statement of facts connected with its phenomena the following general inferences may be derived:

1st. That ice is capable of expansion and contraction.

2d. That ice (up to 32°) expands with a temperature *higher* than that which *had just previously* existed.

3d. That ice contracts with a temperature lower than that which had just previously existed.

4th. That ice does not expand or contract with a uniform temperature.

5th. That ice is susceptible of expansion to a much greater extent than of contraction.

6th. That when ice is equally dense, thick, and glare, and equally acted on by a heated atmosphere, it expands from the centre towards the circumference.

7th. That ice expands towards the line *of least resistance.*

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*Vegetable Parchment.**

Several of our readers are doubtless aware that an invention was not long ago brought before the public, by which common unsized paper was converted into a substance strongly resembling parchment, and which received the name of vegetable parchment or parchment paper. Mr. Gaines was the inventor, but the working of the invention has been undertaken by Messrs. T. De La Rue & Co. The process consists in immersing the paper for a few seconds, in sulphuric acid, diluted with half its volume of water—the acid being afterwards got rid of. The substance thus produced has been submitted to Dr. Hoffman, the eminent chemist, a copy of whose interesting report is now before us; and our readers will probably be glad to have the substance of it laid before them. The substance (says the doctor) exhibits in most of its properties so close an analogy with animal membrane, that the name adopted for the new material seems fully justified. In its appearance, vegetable parchment greatly resembles animal parchment; the same peculiar tint, the same degree of translucency, the same transition from the fibrous to the horn-like condition. Vegetable, like animal parchment, possesses a high degree of cohesion, bearing frequently repeated bending and re-bending, without showing any tendency to break in the folds; like the latter, it is highly hygroscopic, acquiring by the absorption of moisture increased flexibility and toughness. Immersed in water, vegetable parchment exhibits all the characters of animal membrane, becoming soft and slippery by the action of water, without, however, losing in any way its strength. Water does not percolate through vegetable parchment, although it slowly traverses this substance like animal membrane by endosmatic action.

After remarking that to produce a perfect result, attention must be paid to the exact proportion of acid and water, the time of immersion, and the temperature; and after stating that he had proved experimentally that the acid had produced no chemical change in the constitution of the paper, but had caused only a molecular arrangement of the constituents, he says, that he next proceeded to ascertain whether the process employed to remove the sulphuric acid from the paper had produced the desired effect. If any acid remained, the destruction of the paper, within a greater or less period of time, was certain. Now, the process consists in long continued mechanical washing with cold water, immersion in a dilute solution of caustic ammonia, and, lastly,

* From the London Practical Mechanics' Journal, October, 1858.

renewed washing with water. This process was found, on analysis, to have been attended with complete success; for not a trace of free sulphuric acid could be found.

The doctor then performed some experiments on the strength of this material, as compared with that of the animal parchment, with which it is likely to enter into competition. For this purpose, bands of vegetable and of animal parchment both $\frac{1}{8}$ of an inch in width, and as far as possible of equal thickness, were slung around a horizontal cylinder, and appropriately fixed by means of an iron screw clamp pressing both ends upon the upper part of the cylinder. The band assumed in this manner the shape of a ring, into the bend of which a small cylinder of wood was placed projecting on each side about an inch over the band, and carrying by means of strings fastened to each end a pan, which was loaded with weights, until the band gave way. A set of experiments made in this manner led to the result, that paper by exposure to the action of sulphuric acid in the manner described, acquires about five times the strength which it previously possessed, and that for equal weights, vegetable parchment possesses about three-fourths of the strength of animal parchment. It was found, moreover, that bands of vegetable parchment taken from different sheets of the same kind of paper, exhibited a remarkable uniformity of strength, whilst in animal parchment, which, owing to its mode of manufacture, must always present considerable inequality of thickness, extraordinary variations were observed, even if the bands were taken from the same skin. Vegetable parchment, then, as far as strength goes, is not quite equal to animal parchment. On the other hand, the new article greatly surpasses real parchment in its resistance to the action of chemical agents, and especially of water. As has been already stated, vegetable, like animal parchment, absorbs water and becomes perfectly soft and pliable; but it may remain in contact, and even may be boiled with water for days, without being affected in the slightest degree, retaining its strength, and regaining its original appearance on drying; on the other hand, it is well known how rapidly animal parchment is altered by boiling water, by the protracted action of which it is converted into gelatine. Even at the common temperature, animal parchment, in the presence of moisture, is very prone to putrefactive decomposition; whilst parchment paper, in which nitrogen, this powerful disturber of chemical balance, is absent, may be exposed to moisture, without the slightest change either in appearance or properties. It would in fact be difficult to find a paper-like material endowed with greater power of resistance to the disintegrating influences of water than vegetable parchment.

Taking into consideration the chemical composition of the new material, its cohesive power, and its deportment with chemical solvents, especially water, both at the common temperature, and at the temperature of its boiling point, it is obvious that this substance unites in itself, in a most remarkable manner, the condition of permanence and durability; and there need be no hesitation in stating that vegetable parchment, properly prepared, is capable of resisting the tooth of time for many centuries, and that under various circumstances it will last even longer than animal parchment.

The valuable properties of vegetable parchment suggest a great variety of applications for the new material. There is no doubt that parchment paper may be adopted, with perfect security, for all legal documents, policies of insurance, foreign bills of exchange, bills of lading, scrip certificates, and other similar documents, as a substitute for the skins which are now generally used. On the other hand, its comparatively low price would appear to suggest its application in a variety of cases, in which, at present, paper is employed; for instance, for private ledgers of banking houses, or other large establishments, as well as for registries of wills, marriages, baptisms, and deaths, indeed, for all documents the preservation of which is of importance. Many of the documents in question, in order to protect them from injury in case of fire, are generally kept in safes, the majority of which are now encased with solid water,—the water of crystallization in alum, and other similar hydrated compounds. The interior of these safes, in case of exposure to heat, must obviously become filled with steam of a high temperature, and it cannot be doubted that documents written on vegetable parchment, owing to the extraordinary power with which this material resists the action of boiling water and of steam, will stand a much better chance of preservation under such circumstances, than those written on common paper or animal parchment.

As another advantage of vegetable parchment, as compared with animal parchment, the experience may be quoted, that vegetable textures are much less attractive to insects than animal structures. Moreover, to increase the security of vegetable parchment in this respect, the paper, before conversion, may be incorporated with chemical agents which, like salts of mercury, for instance, have been employed with such advantage in the manufacture of paper for public records. Another advantage is, the great difficulty with which words are erased from its surface, and others are substituted in their places. Deeds written on parchment paper acquire thereby a certain degree of security against falsification.

Its strength and resistance to water appear to recommend parchment paper in an eminent degree for engineers' and architects' plans, and especially for their working plans, which are often unavoidably subjected to rough usage and moisture. The thinner sheets of parchment paper, on account of their transparency, present the additional advantage of being useful as a most durable tracing paper. Another field of considerable extent for the application of vegetable parchment appears to be in book-binding, especially ornamental. Books bound in parchment paper are remarkable for the beauty and solidity of their binding. Experienced book-binders, to whom these were submitted, believed them to be bound in real parchment. Even in the manufacture of books and maps, which, like those used for educational purposes, have to stand considerable wear and tear, parchment paper may find a very useful application. The printing on ordinary paper is not changed by the treatment with sulphuric acid, but owing to the shrinking of the paper during the process, it will probably be found more convenient for such purposes to print on the paper after it has undergone the transforma-

tion. Vegetable parchment is remarkable for the facility with which printer's ink, as well as writing ink, may be applied to it, and for its attraction for dyes generally, many of which it appears to take even more readily than calico.

Among the numerous more or less important applications in which parchment paper is sure to be found useful as soon as it becomes accessible to the general public, its adaptation for household, and especially for culinary purposes, must not be left unmentioned.

In closing the orifices of vessels for preserves, &c., few housewives will hesitate to substitute an elegant material like vegetable parchment paper for animal membrane, which is now generally in use.

Formed into bags of which the seams are cemented with the white of egg, parchment paper will be found very useful for the purposes of boiling and stewing, according to the principles of a refined and scientific *cuisine*.

Nor can the chemist fail to derive some benefit from so interesting an achievement of his own science as the transformation of paper into parchment. In the laboratory, vegetable parchment will become a material of general use for connecting retorts and condensers, or other similar apparatus, and on account of its indestructibility by many of the fluids usually employed in electric batteries, it will probably find a further and even more important application in the construction of diaphragms for galvanic apparatus.

Lecture on some of the Improvements in Locks since the Great Exhibition of 1851.* By Mr. Edmund Beckett Denison.

After adverting to the mode in which the old Bramah and Chubb locks had been picked by Mr. Hobbs, of picklock fame, Mr. Denison stated his belief that there was still a notion prevailing among persons, who ought to know better, that the picking of locks by this method required singular skill and dexterity, such as need not be feared from ordinary lock-pickers. This was quite a mistake, now that the method is so well known to every body in the lock trade, and to all who take the trouble to look into any books on the subject. He stated that the long delay of the thieves who opened the box with a Chubb lock on the South Eastern Railway, in the gold dust robbery, only proved that they were greatly ignorant of their business. Any moderately good hand, among, not merely Mr. Hobbs', but Mr. Chubb's own workmen, would have opened the box and shut it up again between London and Reigate. Indeed, in a trial before Lord Campbell, a few years ago, one of Mr. Chubb's men confessed, that the picking of one of his locks, or of any others then known to him, was merely a question of time; and Mr. Hobbs has several times said in public, that he is acquainted with persons, both in the trade and out of it, who can pick locks quicker than he can, now that the proper way of doing it is known. The lecturer strongly recommended, for cheapness and comparative safety,

* From the London Practical Mechanics' Journal, October, 1858.

Tucker's, Parvell's, and Hobbs' small locks. He stated that one of the good effects of the exposure and defeat of our best locks had been the invention of a greater variety of really different locks, in the last six years, than in the previous sixty or six hundred. The greater number of locks now made has induced the formation of an establishment by Mr. Hobbs for their exclusive factory, and in which, like Colt's revolvers and the American clocks, they are made by special machinery. The small prices at which they are sold is, of course, the result of this mode of construction. It was stated that the common three-inch drawer locks, with four tumblers, equal to the best of 1851, are now sold at 27*s.* a dozen. The principle of all locks above the rank of the common warded locks, whatever may be the details of their arrangement, is this:—There are a number of similar pieces (which may have the name of tumblers, levers, sliders, disks, rings, or pins, according to circumstances,) each with a notch in it in a different place, and until all these notches are brought together into one given position, the pieces in question, or some of them, prevent the passage of another piece in the lock, on which its opening depends. Mr. Denison exhibited a model, made not to resemble any particular lock, but to illustrate this general principle of them all; and he showed on it the application of the "tentative" mode of picking, by applying pressure to the bolts, and then gently moving each of the tumblers or sliders, &c., in succession, on which any pressure is felt, until all the notches come under the piece which has to enter them, and then the bolt yields to the pressure and goes back. The lecturer gave a synopsis of some improvements which had been made, and referred with much commendation to the first invention which really defeated this lock picking, by Mr. Hobbs, in what he calls his "protector" or movable stump lock. In this, as soon as you try to make the bolt press upon the tumblers, the pressure is taken off them altogether, and transferred to a fixed pin in the lock, which would prevent it from being opened in that state of things, even if all the tumblers were then raised to the proper height. This is done by the movable stump, the action of which is freely described in the rudimentary treatise on locks in *Weale's Series*. Mr. Denison said that this invention, in its present form, is perfectly effectual against any mode of picking yet known. He then described a lock of his own invention, not intended for furniture and small work, but for doors of safes, prisons, and other places where strength and security are required.

Before the Royal Institution.

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*Type Map.**

A telegraphic map of Europe, entirely executed in typography, has been presented to the Society by Mr. R. Decker, of the Royal Printing Office, Berlin. It is the work of Mr. A. Mahlan, who is employed by Mr. Decker in the above establishment. It is remarkably clear and beautiful. The process by which it has been produced is described as

* From the Journal of the Society of Arts, No 293.

follows:—The drawing of the map, made on paper, is blackened at the back with a carbonic tracing composition, and is placed, blackened side downwards, on a surface composed of quadrats, formed each by sixteen nonpareil squares, and by means of a point the lines are transferred to them. The quadrats over which the lines are traced are then exchanged for nonpareil type, cast with a face of points, and the coast line is formed by the inner portion of these points being cut away. The telegraphic lines are formed of brass rules, fixed in nonpareil type body, as a sort of legs, which can be inserted into the composition, when needed, by taking out the quadrat, the legs being so adjusted in length that the upper edge of the rule is level with the face of the type. The additional shading of the coast line is effected by the insertion of nonpareil type cast with points on the face. The names of places are inserted by means of type taking the place of the quadrats where required.

The effect produced is peculiarly good. How far this is ever likely to supersede the present methods of producing maps by engraving and transfer to lithographic stone, is questionable; no details as to the cost are given, and it seems very doubtful (however simple the process appears,) whether the result can be satisfactorily produced except by a skilled workman, whose labor must be adequately remunerated.

A new form of Mercurial Barometer.

M. de Celles exhibited to the Academy of Sciences of Paris, a mercurial barometer constructed under his direction. This barometer is the instrument of Torricelli, with the following modifications: 1st, the diameter of the barometric chamber is increased in proportion as it is desired to make the instrument more sensitive; 2d, the cistern is replaced by a horizontal tube 0·15 ins. or 0·2 ins. in diameter, and of a length proportionate to the sensibility of the instrument. The instrument has the form of a square. Slight variations of the height of the vertical column correspond to considerable, but always proportional movements of the horizontal leg. This ratio is inversely as the squares of the diameters. An index of iron placed in the horizontal tube is pressed outward while the pressure of the air is diminishing, and is left when the column returns. It marks the minimum pressure, and may be brought back by a magnet. M. de Celles claims for this instrument the three advantages: 1st, of very great sensitiveness. 2d, a constant level. 3d, a minimum index.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, December 16, 1858.

John C. Cresson, President, in the chair.

John Agnew, Vice President.
John F. Frazer, Treasurer.
I. B. Garrigues, Recording Secretary. } Present.

The minutes of the last meeting were read and approved.

Letters were read from the Royal Society, of London, and James Eives, of London; the Royal Cornwall Polytechnic Society, Falmouth, England, and L. A. Huguet-Latour, Esq., Montreal, Canada.

Donations to the Library were received from the Royal Geographical Society, and the Institute of Actuaries, London; the Royal Irish Academy, Dublin, Ireland; L. A. H. Latour, Montreal, Canada; the Fire Department of the City of Detroit, Michigan; the Commissioners of Indian Affairs, Washington City, D. C.; William Lenoir, of Lenoirs, Tennessee; Dr. Charles M. Wetherill, Lafayette, Indiana; Charles E. Smith, Esq., Dr. Isaac N. Kerlin, Messrs. Merrick & Sons, John E. Addicks, Esq., Dr. L. Turnbull, Dr. B. H. Rand, and Geo. M. Conarroe, Esq., Philadelphia.

Donations to the Cabinets were received from Walter Cresson and Amos A. Jones, Esqs., Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of November.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Exhibitions presented so much of their Report on the late Exhibition, as refers to the specimens of velvet and gold stamped paper hangings, by Messrs. Howell & Brothers, of Philadelphia, for which they recommend the award of the Gold Medal. And, also,

To the specimens of mousseline de laine, by the Manchester Print Works, of New Hampshire, and the gas fixtures, by Messrs. Cornelius & Baker, of Philadelphia, for which they recommend to each the award of a Recall Gold Premium.

On motion, the awards were made in accordance with the Report.

Fifty-nine resignations of membership in the Institute, were read and accepted.

Candidates for membership in the Institute (141) were proposed, and the candidates (6) proposed at the last meeting were duly elected.

Prof. John F. Frazer announced the death of Mr. Owen Evans, and offered the following resolutions, which were seconded by John E. Addicks, Esq., and unanimously adopted:

Resolved, That the Franklin Institute has heard with great regret, the announcement of the death of their late fellow-member, Mr. Owen Evans.

Resolved, That as a member of this Institute of twenty-four years' standing; for fourteen years an active member of its Committee of Exhibitions, and of its Board of Managers, he always commanded the admiration of his fellow-members for his zeal and energy, and endeared himself to them by his amiable manners.

Resolved, That the Corresponding Secretary be directed to communicate to the family of the deceased, the expression of our sympathy in their affliction.

Nominations were made for Officers, Managers, and Auditors of the Institute for the ensuing year.

On motion, it was

Resolved, That the polls for receiving the votes of the members of the Institute for Officers, Managers, and Auditors for the ensuing year, at the Annual Election to be held on Thursday, Jan. 21st, 1859, shall be opened at 3½ o'clock, and closed at 8 o'clock, P. M., and that seven members be appointed by the President a committee to receive the votes, and report the result thereof.

Messrs. Field & Hardie furnished one of Mr. L. C. Stephens' "Patent Combination Rules," a full description of which will be given in the *Journal* for next month.

Mr. G. Curtis exhibited a patent Horse Hoe, the invention of Mr. Lorin Wetherill, of Worcester, Mass. It is designed for hoeing corn, potatoes, cotton, or other field crops that are grown in rows or drills; and is adapted to the condition of the plants in any stages of their growth. It consists principally of a double mould-board plough, having at its rear sides two sets of hoes or paddles, affixed to the ends of arms that rotate in planes perpendicular to the furrow made by the plough. Motion is given to these arms by shafts driven by gearing moved by a wheel running upon the ground just in advance of the plough. The shafts can be raised or lowered at the ends carrying the hoes, in order that a lesser or greater quantity of earth may be thrown by them upon the hills surrounding the roots of the plants. The clods are broken by the hoes into small pieces, which consequently lay more closely about the roots.

It is claimed to be an efficient and labor-saving machine, hoeing as much ground in one day as the draft animals can pass over.

BIBLIOGRAPHICAL NOTICES.

The Coast Survey; its Costs, Abuses, and Power. From the New York Times.

The pamphlet before us with the above title, contains a violent attack upon the Coast Survey, or rather upon its superintendent; but the malice and personal spite of the writer is so marked upon every page and almost every paragraph of it, that were it to meet the eyes of intelligent men only, it would scarcely merit a notice in reply.

From the character of the writing, however, and the great exertions which have been made to distribute it wherever it might do harm, it is evidently intended to furnish a pretext, rather than a reason, for an attack upon this important work, and the silence of those who know its falsity, was not improbably one of the elements calculated on to secure its success.

Fortunately, our duty does not call on us to follow the writer in his

mere personal abuse; the fact which underlies this very pamphlet, the great personal popularity and influence of Mr. Bache, and his position as a formidable opponent to all who have other purposes to serve than those of science and patriotism, is a quite sufficient answer to all this: let us turn to what, we will, by courtesy, call the *argument* of the pamphlet.

Reduced to propositions, it appears to be, that the Coast Survey is a very costly work; much more so under Mr. Bache, than it was under Mr. Hassler; that it employs a great number of persons; and that the Superintendent is at the same time a member of the Light House Board; a Regent of the Smithsonian Institute, and an influential member of the American Association for the Advancement of Science.

The inference which the anonymous author would willingly have his readers draw from all this is, that Mr. Bache abuses his influence for his own personal ends, or for the advancement of his friends, but as this is nowhere distinctly alleged, and especially as no specific cases of such action are brought forward, we may pass such inference by for the time; certain that when any attempt is made at such allegations and proofs, their utter falsity will be abundantly demonstrated, and perhaps a righteous lesson be taught to anonymous libellers.

The Coast Survey is undoubtedly an expensive work, and it was the duty of the Government before instituting it to satisfy itself that the benefits to be derived from it were commensurate with its probable expenditure; and it is the duty of Congress now, to be satisfied that every dollar which is appropriated to it, is necessary for the attainment of these benefits. That this has been the case heretofore, any reference to the Congressional documents and the debates, all of which, notwithstanding the implied statement of this pamphlet, are accessible to any one who desires to be informed on the subject, and especially to any one residing in a city or town where there is a public library of any importance, will show.

In one of his early reports, the present Superintendent submitted to the Government, two alternatives; the continuance of the survey on the scale which had been adopted up to that time; and its enlargement, and consequently an increased annual expense; and he pointed out, that the latter plan would, by hastening the completion of the work, and allowing it to be carried on at all seasons of the year, be the more economical in the end; besides fulfilling more perfectly, the practical purposes for which the Survey was originated and maintained.

The Secretary of the Treasury and the Committees of Congress, and all subsequent Secretaries and Congresses were convinced that he was right; the scale of the Survey was enlarged, and when it became important, if not absolutely necessary, to put our Pacific Coast also under survey, a large additional expenditure was at once and with great unanimity granted. There has probably never been a great policy in our country which has met more general approbation from statesmen of all parties, and of all sections of the country, than this. And the few exceptions, (and our pamphlet makes the most, of the only distinguished one, that

of Mr. Benton,) are easily understood by those who know the circumstances, and can hardly make an offset against the overwhelming favorable opinions. We infer from this, that inasmuch as, every year, the accounts of the Coast Survey have been submitted to examination, by able men of all the political parties, and of the most varied shades of personal opinions and influences, and since no charge has ever been heard of the smallest misapplication of the moneys, either from political or personal favoritism, we infer justly and inevitably, that each successive Congress, from the time that the present Superintendent took charge until the present, has been satisfied that the moneys appropriated have been honestly and judiciously applied to the purposes for which they were intended. But it is perfectly proper that every citizen of the United States should satisfy himself on the fundamental points of this matter; and, since the expenditures are necessarily heavy, answer for himself the questions; are the benefits derivable from the Survey such as to compensate for its expense? and can these benefits be secured with less outlay?

Now the chief motives which led Mr. Jefferson to propose, and have since led his successors to maintain the Coast Survey, are, as we take it, as follows:—

That we have an extensive sea-coast, and one of a very dangerous character: lying in such a position in reference to our commerce, as to make it a lee-shore for at least one-half of the prevailing winds; low, abounding with shoals, and subject to violent storms. Yet along this coast the whole of our internal commerce is compelled to pass, at all seasons of the year, and under every disadvantage: while, from the peculiar position of our principal ports, our foreign commerce is subjected to scarcely less danger. But commerce is one of the principal industries of our country, and one which it has always been the obvious policy of our Government to protect and encourage. An accurate survey, and abundant and good charts of this dangerous coast are therefore a national necessity; and the least inquiry will satisfy any dispassionate mind, that the actual pecuniary benefit of the Coast Survey, as represented by valuable cargoes saved, and a diminished rate of insurance rendered possible by its labors, would, in a single year, re-pay almost the whole outlay upon it since its commencement. And not only our merchants and the inhabitants of the coast, but every dweller in the land participates in this benefit, since such improvements present themselves to him in the diminished price of goods, and more easy communication with foreign countries.

Again, it is the interest of every industrious dweller in the land, that the capabilities, facilities, and difficulties of every port upon our coast should be thoroughly investigated and widely published, and this can be done only by accurate surveys made on the same plan, and all the appliances which an extensive operation can give.

And, finally, while we encourage emigration from abroad, and hold out inducements to millions of industrious men and their families to leave their own homes to give us strength and importance, it is a duty which we owe to the community of civilized nations, and one which is

enforced by all the considerations of humanity, to publish and diffuse as widely and rapidly as we can, accurate charts of the approaches of a coast which is known as one of the most dangerous in the world.

Indeed, so forcible are the pleas for the Coast Survey, that even our author does not directly attempt to undervalue its importance, but pleads only for the discharge of the present Superintendent, which action would doubtless answer all his purposes. But to this proposition there are some serious objections.

In the first place, the peculiar practical features of this Survey, those which give it its greatest value, to wit: the vast extent over which its examinations are extended at the same time, and the rapid publication of its results, are due entirely to Mr. Bache, and have never before been attempted in any similar survey. The late Mr. Hassler, who was an excellent and competent man, evidently regarded his survey rather in the light of a scientific problem, than as a work of practical importance to our country. Hence, his work was performed leisurely, and by a few parties; and hence, when he died in 1842, even his primary triangulation had not extended beyond Rhode Island on the East, and the shores of Delaware Bay on the South, and not a map had been published. In the fifteen years which have elapsed since then, under Mr. Bache's supervision, "the reconnoissance has been extended over 40,000 square miles; 8 primary and 41 secondary base lines have been measured; 30,000 square miles of primary triangulation have been executed; 15,000 miles of shore line surveyed by the plane table; the positions of 5000 points determined; 3,500,000 soundings made; 1400 manuscript maps executed. The record of triangulation fills 600 volumes; and of astronomical observations, 460 volumes; the record of computations, 800 volumes, and of tidal observations, 1200 volumes; 345 electrotype plates have been executed; 280 preliminary charts and sketches, and 52 finished maps published, and 90,000 copies of the same distributed."

This, it will be observed, is quoted from a report to which the author of our anonymous pamphlet, as well as any other inquirer, has access, and from this it appears that, while the average yearly expenses of Mr. Bache's survey, exceed those of Mr. Hassler in the ratio of 4 to 1, the amount of work done is greater in the ratio of 7·3 to 1, showing an economy of 27 per cent. in favor of the present method of conducting the survey.

Do not let us be understood in this comparison as underrating or reflecting on the labors of Mr. Hassler: he was an upright, laborious man, and an excellent Superintendent. Some of the work above enumerated was not possible in his day. But what we want to show is, that he has had a worthy successor: nor do we hesitate to affirm that if we should by any chance lose the services of Mr. Bache, it would be impossible to replace him in this country, (or, as we believe, in any other.) If Mr. Everett ever said, (and we want better evidence of it than our author's assertion,) "that the entire work is one of practical astronomy," he made a very great mistake. Besides a practical astronomer, it requires a physicist of high power, a surveyor, a mechanic,

and above all, a governor; one who can appreciate the work which his subordinates are doing—can applaud judiciously the merits, point out the defects, suggest remedies, counsel experiments, and inspire every one with zeal and energy to work.

Now let us look at the second question. Can these results be obtained with less expenditure? The only mode of judging of this, by the majority of men, must be by comparison with similar works executed in other countries, and we again refer to documents which are accessible to every one, for our data of comparison.

According to the pamphlet which we are examining, our Coast Survey cost, while under Mr. Hassler, from 1807 to 1842, $730,900, and under Mr. Bache from 1843 to 1858, $4,321,110; in all, $5,052,010; and it appears that Mr. Bache employs 68 subordinates.

"The trigonometrical survey of Great Britain and Ireland was begun in 1791, and had cost, up to 1856, $12,000,000; and it is estimated that $8,000,000 will be required for its completion. The whole number employed on the survey in 1840, was 3500. The hydrographic surveys of England have cost, in the last twenty years, $10,000,000; the average number of persons employed yearly in these surveys is 1500."

(It will be remembered that our Coast Survey includes the hydrography).

"The surveys of France have been in progress nearly 100 years. The length of the Coast of France is about 600 miles only, and its survey required 28 years for its completion. The cost of the hydrography of France, alone, since 1854, has been, $4,300,000."

These examples of the two great commercial nations will probably suffice. It shows the comparative rapidity and economy of our survey, and the testimony of their scientific men, as well as of our own, will establish its accuracy.

We claim, therefore, to have vindicated the Coast Survey from the unfounded calumnies of the author of this anonymous tract. We have no time to allude to the Light House Board, &c., except merely to remark: That if the Government, exercised as it has been since Mr. Bache's residence at Washington, by all political parties, and by individuals who were bound to him by no ties of relationship, or personal friendship, have thought it expedient to use his talents and industry, in perfecting that portion of their administration where scientific knowledge is necessary, they have, we think, done well, and we hope they will continue to do so in future.

Whenever Mr. Bache is found guilty of perverting his position for political or personal purposes, he will sink nearer the level of anonymous writers, and their attacks may do him more harm.

To show the different estimate which foreign men of the highest character, and competent to judge of Mr. Bache's labor, put upon his work, we subjoin an extract from the address of Sir Roderick Impey Murchison, on presenting the Victoria Gold Medal to Mr. Bache. And when an English Society bears testimony to an American man of science in such terms as these, you may believe them. F.

"Operations of this nature will of course have been made available for a correct delineation of all the surface of the interior; for it is manifest that every triangle referable to a known unit furnishes three decided bases with which others may be connected in any direction, as long as there remains a *terra firma* for the instruments to stand on; but these internal operations, being more of a domestic nature, do not appear to the Council to establish any distinct claim to the medal. The case, however, is very different when we come to consider the accurate delineation of such a coast as that of the United States, commencing at the State of Maine, comprising no less than eighteen States on the Atlantic and Gulf of Mexico, besides others on the Pacific, and extending, as we are credibly informed, over not less than 30,000 miles. This number no doubt includes all the windings and indentations of the coast, and the interiors of its harbors, the islands, &c.; for it is to be remarked that, by the especial provision of the Government of America, the duty is not confined to one class of persons, but is shared equally by military and naval men and civilians, all chosen for their fitness; whereby not only is the field for selection vastly expanded, but a greater facility of correctly taking soundings and delineating shoals, harbors, and isolated rocks, is afforded.

"It would be impossible to do justice to an extensive work of this sort on an occasion like the present; but as the previous reports of this celebrated Coast Survey, from 1844 to 1845, inclusive, are in our library, those of our associates, and of the public generally, who wish to form an estimate of their value, can do so at their leisure, and they will see how vastly our medallist has pushed on this great work. *They will assuredly then rise from the examination with the thorough conviction that, whether we regard the science, skill, and zeal of the operators, the perfection of their instruments, the able manner in which the Superintendent has enlisted all modern improvements into his service, the care taken to have the observations accurately registered, his modest and unpretending demeanor, or the noble liberality of the Government, tempered with prudent economy, all unprejudiced persons must agree that the trigonometrical survey of the United States of America stands without a superior.*

"What, then, are we to say respecting the accurate delineation of this immense tract of coast, so much frequented by commerce, so important in every point of view to mankind at large, but that it is a great and universal boon conferred on all the inhabitants of this globe? We all benefit by the security of navigation: it is not the Government of the United States of America alone which derives an exclusive advantage from this admirable series of operations, but those who have most frequent access to the shores of the Atlantic and Pacific chiefly participate therein; and as Great Britain stands foremost amongst these, on whom can we so deservedly bestow one of our two royal gold medals this year?

"The grounds for making the award of the highest distinction which it is in our power to confer have been expressed in the terms sanctioned by the Council; but that document does not allude to other great qualities of a man who, besides his admirable Coast Survey, has so largely extended our knowledge on various subjects of scientific importance. I may here cite his delineation of the iso-magnetic curves both in Europe and America; his littoral and deep-sea soundings, which, it is believed, will soon enable us to read off the natural history of the Gulf Stream, and to calculate the periodicity and perturbations of the tides at given spots; and his many ingenious inventions, including a method of registering the pulsations of distant earthquakes."

The U. S. Naval Astronomical Expedition to the Southern Hemisphere, during the years 1849–1852.

At the suggestion of Lieut. J. M. Gilliss, L L. D., and under the influence of strong recommendations from the American Philosophical Society, at Philadelphia, and the American Academy of Sciences, at Boston, Congress authorized the fitting out of an expedition to South America; the principal object of which was to test the value of a new method proposed by Prof. Gerling of Marburg, for determining the distance of the earth from the sun, which is the fundamental unit of all astronomical measures; but as to the value of which various serious doubts exist, owing to the fact that the determination rests upon

observations of a phenomenon (the transit of Venus,) very difficult to observe with the required accuracy, and happening but once or twice in a century. The discussion of the observations of 1761 and 1769, by Encke, led to a determination of 95,360,000 statute miles for the mean distance, and this has been generally accepted, for want of a better value. Very serious doubts have, however, always been entertained of its correctness, for many of the observations, and some of the most important of them, were unsatisfactory; and since no transit of Venus will again occur until 1874, and this, and those following for more than a century, will be unfavorable for the determinations wanted, Prof. Gerling proposed a mode to attain the same object by observations of the planet Venus, when nearest the earth, made simultaneously at two observatories, nearly on the same meridian, and as widely apart as possible in latitude. These observations, as we have said, the U. S. Government undertook to have made here, and at Santiago, in Chile; and excellent instruments were procured, the expedition organized, and Lieut. Gilliss, with three officers of the Navy, who volunteered, as his assistants, were sent out to make the observations.

As they proposed a prolonged stay in Chile, for the purpose of observing at two consecutive returns of Venus to inferior conjunction, it was, of course, intended to occupy the intervening time by observatoins astronomical, and others; especially in observing the planet Mars when nearest the earth, for the same purpose of determining the earth's distance from the sun (which had already been attempted, but with unsatisfactory results), and making a catalogue of the fixed stars of as large a portion as possible of the Southern Hemisphere.

The results of this expedition, which possess a very high scientific value both from their nature and the known competency of the superintendent, have been published by Congress in five well printed quarto volumes. The third of these contains the observations on Mars and Venus, with their discussion and reduction by Dr. B. A. Gould, Jr.

Unfortunately it has happened, how we cannot explain, that while so much pains and so much money was spent, and laudably spent, upon this expedition, the corresponding observations in the United States, which were essential to its success according to the method proposed, were almost entirely neglected; so that while we have from Chile an excellent set of observations upon 217 days, extending over nearly 3 years, we have to compare with them in all but 24 observations made in the United States, and 4 at Greenwich (England). And of these 28, but 8 were upon Venus, the planet especially selected as giving by far the best data for the problem; and these only corresponding to Lieut. Gilliss' first series; for his second series, to make which he remained so long abroad, not a single corresponding observation is to be found in the United States. How this has happened is not explained, yet nothing appears to require more candid explanation. Before the departure of the expedition, a circular was issued by Lieut. Maury, the Superintendent of the Washington Observatory, which is under the control of the same department of the government, under whose auspices Lieut. Gilliss was sent out, calling on all friends of astro-

nomical science in the United States to co-operate in promoting the objects of this important expedition. Yet, with a number of well furnished observatories in our country, we get nothing but this poor response, and the whole expedition is allowed to fail, for fail it did, in its main purpose. The method of Prof. Gerling remains untested; and although we have a new determination of the parallax, thanks to the consummate skill and industry of Dr. Gould, it rests on comparisons which are not sufficient to give it authority against the previous determination of Encke, from which it differs by a material amount.

Of course, if the independent observatories did not choose to enter into this scheme, nothing farther can be said. We may regret their want of national spirit, and see plainly that they are not governed by scientific aspirations, but farther we have no right to go. But the government who fitted out this expedition, have two observatories, one at Washington, under the control of the Navy Department, and one at West Point, attached to the Department of War. What were they doing? Was Venus visible but five nights during the period for corresponding observations? or did other still more important duties (we cannot imagine such,) prevent them from doing their share? If this be so, why is not the explanation made in the report, that the reproach which now rests upon us may be taken away? One or two additional observers, if necessary, might and ought to have been placed at each competent observatory in the United States, that the pompous language of the report in Congress about our "American contributions to science," might have been sustained. As it is, we occupy a worse position than if we had never undertaken the expedition.

Great credit, however, is due and should be given to those who were actively engaged in this matter, and especially to Lieut. Gilliss, for his zeal in its inception and carrying out, and his skill in observing, which becomes evident from the discussion of the observations. To Mr. Gould, who, for the ability and labor displayed in doing the best he could with his materials, the thanks of scientific men are due. It will be hard, indeed, if his capabilities as an astronomer are doubted when he has such a demonstration of them to produce.

His result is, that "the sun's equatorial horizontal parallax" (at his mean distance from the earth), is 8·5″, being less by 0·07″ than the value commonly adopted, and corresponding to a distance of 96,160,000 statute miles from the earth. F.

The Mathematical Monthly. Edited by J. D. Runkle, A. M., Cambridge. John Bartlett.

Such is the unpretending title of a new Journal devoted to science, of which the first three members have reached us. Its objects as declared in the introductory note, and in the prospectus which announced the intention of establishing it, are the advancement of science and the elevation of the standard of mathematical learning in this country. It proposes to accomplish these, by the proposal of problems suited to all

grades of students in mathematics, from the beginner, who feels for the first time the desire to exercise his newly acquired sense, to the veteran, who wishes to test his own mature powers, or try the strength of his competitors by a friendly challenge, or to communicate to the world the results of his studies; and by the publication of "all scraps of mathematical writing too good to be lost, whether elementary or profound, whether original in manner or matter, whether complete in themselves, or to be resumed at the convenience of the author;" as well as of "carefully elaborated essays." In addition, the editor submits this proposal, which, if it meet with the attention which it deserves, will be of vast importance to the progress of science amongst us. "All mathematicians know that there are many subjects in the higher departments of the sciences upon which, little, if any thing, has as yet been written among us. Now, if they will take these subjects and develop them fully and systematically through the pages of the Journal, they may afterward be issued in a separate form from the stereotype plates, at a very small cost. In such cases, the right and benefit thereof shall vest in the author."

It requires no argument to show that a periodical conducted in accordance with these views, is much wanted in this country, and that, if ably supported, will be of the greatest benefit to our science. As to the ability with which it is likely to be conducted, the character of the editor, and the list of names of those who have promised their active support, including, as it does, those of our most eminent men in this branch of science, and of almost all of them, is more than a sufficient guarantee.

To those whose experience has taught them to rely less on things promised than on those performed, an examination of the three numbers already published must prove satisfactory.

They have already given us a number of ingenious and useful suggestions of problems suited to various degrees of mathematical ability; but the gem of the collection, is an account of the late great comet, (1858, V. Donati,) as it appeared in the great Equatorial Telescope at Cambridge, contributed by G. P. Rand. The value of this paper as a contribution to our knowledge of the nature of comets cannot well be overrated, and, although in no wise mathematical in its form, it is worth close investigation by the mathematician as giving requisite data for his researches.

The appearance of this Journal is in all respects worthy of its other high merits. The form is convenient, the type excellent, the page handsome, and the plates illustrating the appearance of the comet, worthy of high praise for their artistic excellence.

Let every one who reads our notice take pains to satisfy themselves that we are not exaggerating the praise deserved.

We hope that the enterprise may prove successful. It is highly honorable to Mr. Runkle to have attempted this thing, it will be discreditable to our country if it does not succeed. Should its success equal its merits, both the editor and the country will have cause to congratulate themselves.

F.